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Automated Attendance System

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Abstract: The typical method of taking attendance is done manually by the teacher or the administrator which requires sizeable amount of time and efforts also involving proxy attendance. As the number of students are increasing day by day, it is a challenging task for the universities to monitor and maintain the record of the students. Automated systems involving use of biometrics like fingerprint and iris recognition were developed previously which have limitations like intrusive nature and time inefficient. To overcome these issues, biometric feature like facial recognition can be used which involves the phases such as image acquisition, face detection, feature extraction, face classification, face recognition and eventually marking the attendance and to calculate the total count with percentage. The algorithms like viola-jones and hog features along with svm classifier are used to acquire the desired results. The problem of redundancy in manual records and keeping attendance is solved by this system. Quantitative analysis is done the basis psnr (peak signal to noise ratio) values.

I. INTRODUCTION

The process of obtaining the identity of a person from an image can be successfully performed by only looking at their face. In fact, identifying a person can be broken down into two distinct stages. Firstly, there is face detection – which involves identifying any potential faces within the image. The second stage is face recognition – which involves taking detected faces and classifying them using an already existing database of faces.

Psychophysical experiments show that the human visual system can identify faces from novel images despite considerable variations between images of the same face that are due to changes in illumination [3] and viewpoint [4], [2], [1], [3]. The question, then, is how a recognition system can identify a face despite these variations. Here we focus mainly on variations that are due to changes in illumination. We present an empirical study that evaluates commonly used approaches to overcoming image variations because of these changes. We also evaluate how these approaches affect variations between images of the same face because of changes in viewpoint and expression.

1) *Face Database Creation of Students:* Pictures of all students are captured in different angles with variety of gestures i.e. each student has 8 to 10 pictures angled at different positions. The RGB images are cropped and converted into grayscale and resized to 112*92 pixels in order to reduce the computational time. Folder named 'Database' containing the subfolders, each subfolder contains multiple faces of single person and the corresponding name is given to the subfolder. Fig 1 shows all the faces of single person.
2) *HOG Features:* Object detection is accomplished using histogram of oriented gradients(HOG) [6] which is a feature descriptor widely used in computer vision. It is based on counting the occurrences of gradient orientation in localized portions of an image. This method has similarity with edge orientation histogram, scale invariant feature transform descriptor, shape contexts. However, overlapping local contrast normalization is used and computed on a dense grid of uniformly spaced cells in order to improve accuracy. Implementation of the HOG descriptor algorithm [7] is as follows: ¬ The image must be divided into cells formed by dividing image into small connected regions and calculate histogram of gradient directions or orientation of edge within the cell. ¬ As per gradient orientation discretize each cell into angular bins. ¬ Each cell's pixel contributes weighted gradient to its corresponding angular bin. ¬ Blocks which are spatial regions are formed by the groups of adjacent cells. ¬ Normalized group of histograms represents the block histogram.
3) *SVM Classifier:* The major process in object recognition using histogram of oriented Gradient descriptors is to feed the descriptors into some recognition system based on supervised learning. The Support Vector Machine (SVM) classifier [8] is a binary classifier where optimal hyper plane is used as decision function. The decisions can be made by SVM classifier regarding the presence of an object such as human, once trained on images containing some particular object.
4) *Comparison Recognition:* Extracted binary features of 'Test' faces are compared with the extracted binary features of 'Database' faces, the face having the maximum amount of correlation is recognized as matched face and corresponding name of the face is extracted from the database using the classifier.

5) *Attendance:* After extracting the name of the matched face corresponding attendance is marked in the work sheet named as attendance. mat.
6) *Face Detection:* The face detection algorithm is based on the work from Viola and Jones in [10] – mainly because of its fast execution speed.

II. METHODOLOGIES

1) *Classifier:* The first step towards building a detection system is to train a classifier. Viola and Jones [10] used AdaBoost for training although they mentioned that other machine learning techniques may be just as effective. One drawback to building a classifier is the sheer amount of training data required (5000 facial images and 10000 non facial images in Viola and Jones). It was also mentioned that training time for the classifier was on the order of weeks (although technological advancements would greatly reduce that today). For successful real-time face detection, it is only necessary to use a classifier – not necessarily build it. Thus, because of the drawbacks mentioned above an already available classifier is used: the haar cascade frontal face default provided with OpenCV [12].
2) *Preprocessing:* The only preprocessing performed on the image is converting it to grayscale. ImageJ [13] is used to aid in the conversion. Variance normalization is not performed on the image as a whole, but during the process of the algorithm, it is applied on each sub-window.
3) *Features:* It has been shown in Viola and Jones [10] that rectangular features can be used to represent and detect a face if used in a large number.
4) *Integral Image:* The integral image at a particular pixel is defined to be the sum of the pixels above and to the left of that particular pixel. Thus, mathematically the integral image at position (x; y) can be defined as:

$$ii(x, y) = \sum_{a \leq x} \sum_{b \leq y} i(a, b) \qquad (1)$$

where ii(x; y) is the value of the integral image at (x; y) and i(a; b) is the value of the original image at (a; b). The advantage of calculating the integral image for each pixel is that calculating the value of a rectangular feature can be done in 4 array references. If the top left corner of the rectangle is at position (x1; y1) and the bottom right corner is at (x2; y2), then the value of the rectangular feature is:

$$rect = ii(x_1, y_1) - ii(x_1, y_2) - ii(x_2, y_1) + ii(x_2, y_2) \quad (2)$$

5) *Passing the Classifier:* The classifier being used consists of a number of stages and each stage consists of a number of features. At a particular stage, a sub-window can only pass that stage if the sum of the values generated by testing various features (specified in the haarcascade frontalface default classifier) is above a certain threshold. For the sub-window to be considered as a face, it must pass all 25 stages.
6) *Merging Detections:* Viola and Jones [10] said that they merged all overlapping detections. However, if two faces are close together this could accidentally be counted as a single detection. Instead a merging algorithm partially based on work done by Rowley et al. in [14] was constructed. For each pair of rectangles i and j, the rectangles can be said to be detecting the same face if both (3) and (4) hold.

$$distance(c_i, c_j) \leq t \times width(i) \qquad (3)$$

$$distance(c_i, c_j) \leq t \times width(j) \qquad (4)$$

where ci is the centre of rectangle i, cj is the centre of rectangle j and t is a threshold chosen to be 0.2 [14].

7) *Improvements:* Viola and Jones [10] mentioned that they used a scaling factor of s = 1:25 for the scaling of the sub window. However, on implementation it was found that using a smaller scaling factor of s = 1:1 improves the detection rate. Decreasing the scaling factor directly results in an increase in execution time, however experimentation still showed this to be a fair trade-off.

8) *Face Recognition:* The eigenfaces technique is used for face recognition. One of the key advantages of this algorithm is the very quick classification of the probe/test image.

a) Training: Recognition must be performed against a base set of known images. This set is typically called the training set. The basic steps of the eigenfaces algorithm from Turk and Pentland [11] are then performed on the training set. These steps involve:

i) Calculating the average face from the training set.

ii) Subtracting the average face from each of the original faces.

iii) Placing each of the above face vectors in a row of a new matrix A.

iv) Performing eigenface decomposition using the Colt mathematics library [15] on the product of ATA to produce the set of eigenvectors v.

v) The eigenvectors v are then multiplied by A to effectively form the set of eigenfaces u.

vi) A matrix of weights is then calculated. The weight matrix represents the weighting in which each eigenvector counts towards a particular image.

b) *Classification:* When a testing image is inputted, the algorithm must be able to classify the face in the image as one of the subjects in the database. Some systems have an option which allows for the testing image to not be in the database (an unknown face). However, it has not been implemented for this paper, since it was not used by the eigenfaces algorithm for the Feret database [16], [17] – the main testing source used here. Again, the steps described in Turk and Pentland [11] are performed on the testing image, involving:

i) Average image is subtracted from test image.

ii) Multiplying uT with the result of the above step to get a vector of weights. These weights are then compared to the weights of the training images/database images. A distance classifier is used to determine the distance between the test image and each of the training images. The person in the test image is classified to be the person in the training set who had the least distance between their training image and the testing image.

c) *Distance Classification:* A number of nearest-neighbour distance classifiers exist as described by Moon and Phillips [18]. Manhattan distance and Euclidean distance are both implemented and comparisons of the performance of these two distance classifiers will be mentioned in the results section.

III. CONCLUSION

This paper has analyzed various algorithms for face detection and face recognition with regards to their suitability for use in a real-time application. Furthermore, it has been shown that common, well-known algorithms for both detection and recognition can be combined for real-time use. In order to improve on recognition results, a more astute method for selection was developed. Many of the new selection algorithm techniques show improvements over the baseline results as can be seen in Table III. It is noted that weighting the images within a class gives the biggest improvement. Thus, a direction for future research would be to expand on the weighting selection algorithms given in this paper.

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BIOGRAPHY

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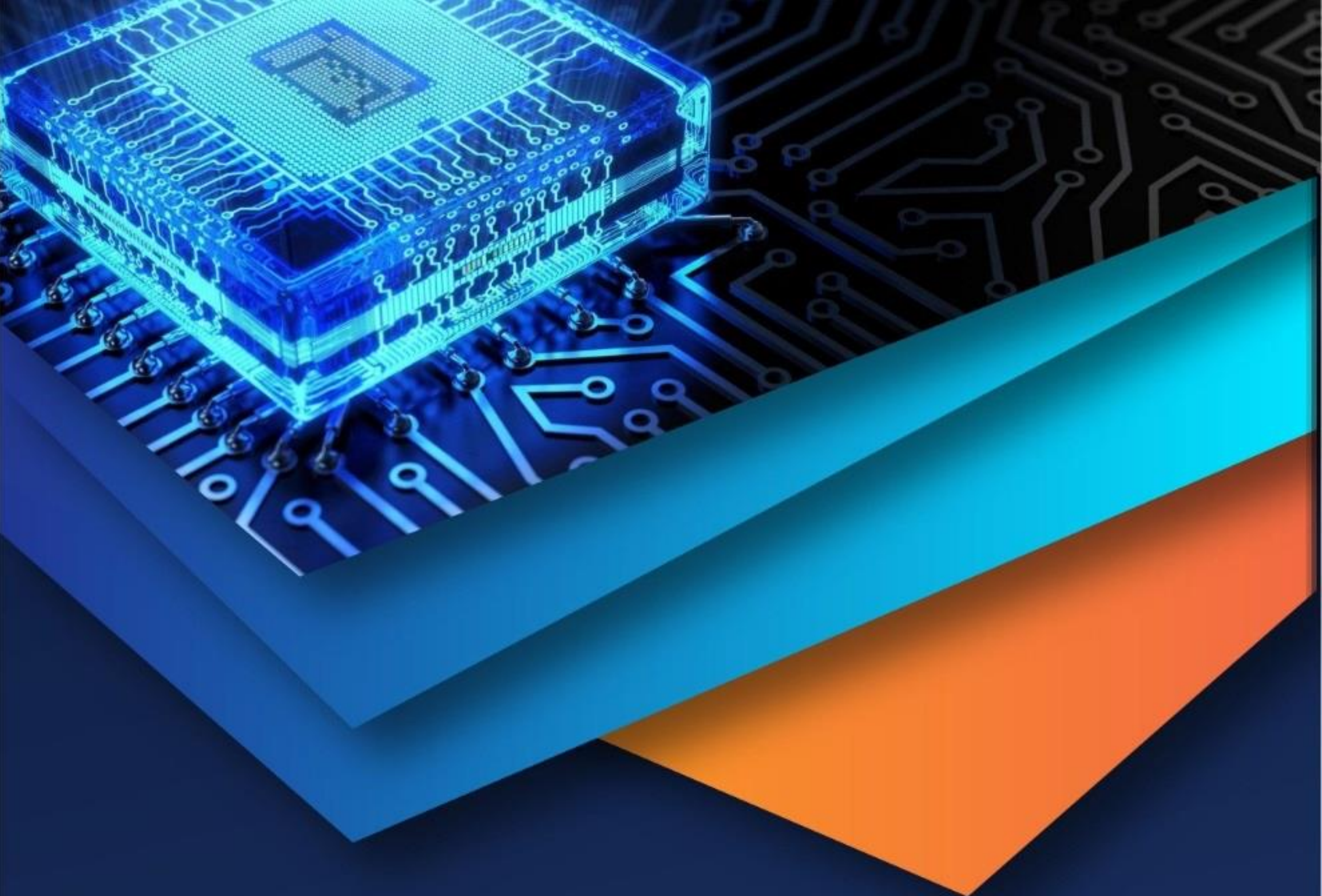

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