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Face Recognition in Real Time for Attendance Marking System

Shubhankar Sharma*, Tanushree Gupta, Risheek Kumar
ECE, Bhagwan Parshuram Institute of Technology, Delhi, India

ABSTRACT

The face recognition system is developed to be operated in real time, scanning, comparing and giving the desired output with minimal time delays. This paper describes an Error Correcting Output Codes (ECOC) based model which has been used in our software. ECOC is an output representation method capable of discovering some of the errors produced in classification tasks. ECOC classifier is used for training and improving the generally use feed forward neural networks (FFNN), in order to enhance the precision of the classification systems. The experimental results on the database made from the pictures of students of Bhagwan Parshuram Institute of Technology show the correctness and authenticity of our model. With a minimal delay and error rate high reliability is achieved. The paper is concluded with future uses of this model and concept.

Keywords: Face Recognition, ECOC in face recognition, Facial Features, Face Extraction, Face Registration , Normalization of faces, Error correcting output coding, Error Back Propagation algorithm, Face Recognition, Face Database, Face Detection, Face Recognition..

I. INTRODUCTION

In present scenario, Human face detection by computer systems has become a major field of interest. Face detection algorithms are used in a wide range of applications, such as security control, video retrieving, biometric signal processing, human computer interface, face recognitions and image database management. Hence, it has become an active area of research at industrial, commercial and defence level. The main interest in face recognition stems need to provide support for human security efforts. For example, by scanning the faces of people entering a secure or restricted area, a face recognition system could be used to control entry. Similar defence related applications of face recognition can easily be found in antiterrorism and antinarcotic operations. As an answer to this need, AFIT (Air Force Institute of Technology, USA) first developed the Autonomous Face Recognition Machine[1] (AFRM) which scans a room and identifies all the faces in the room. Unfortunately, the AFRM had limited accuracy. In order to improve the accuracy of machine based face recognition, many researches have been made till now based on many theorems /classifications which is used in face recognition mechanisms. The purpose of this research is to implement and develop face recognition algorithm. Even though all biometrics has its own unique positive value, no single biometric trait has been identified as fully stable or distinctive for now. This is where the multimodal biometric takes its role as the combination of several biometric systems to make it even more secure and powerful. The goal of this research is also to test and develop face recognition as part of future multi-modal biometrics application by taking Attendance System as its case study.

II. METHODOLOGY

The methodology followed includes a systematic approach of face detection, feature abstraction, comparison with database and output generation. The software developed is made to work in real time with minimal delays to give optimum results.

Figure 1. Basic Block Diagram

A. Face database/gallery

The first and foremost requirement of the face recognition system is the database of facial images of students of Bhagwan Parshuram Institute of Technology whom are to be recognized. It can be referred as Face Gallery. The face gallery consists of static pictures of each student with many different orientation and relatively different expressions. The database is compressed so that a large number of pictures can be stored. For each person/individual a total of 200 different images has been stored in the database.

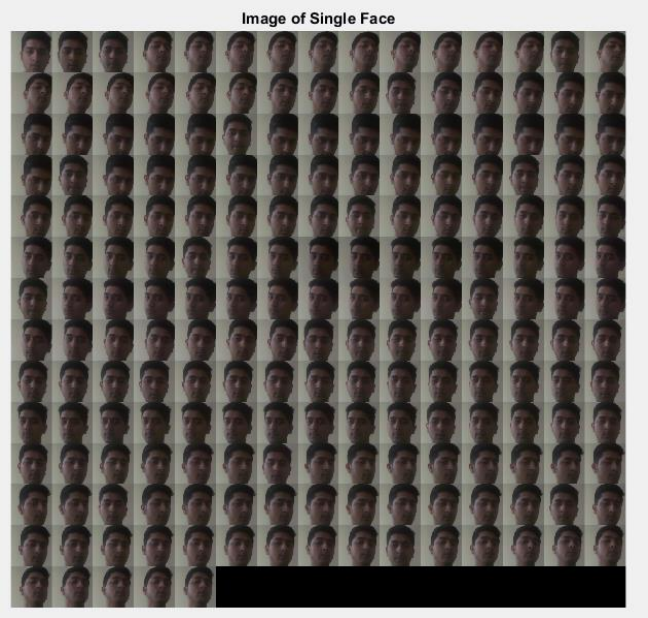

Figure 2. Database pictures

In the figure (ii) there is a block of pictures of the same student and each cell of the block has a different picture. Initially for the project the Yale database was used but later on for practical implementation a new database was created.

B. Face detection and Feature Extraction

Face Detection[2]:- The face detection algorithm is used on the input face query image to find the location of the faces in that image.

Feature Extraction[3]:- It is a processing step which is performed on the images stored in the database as well as the image which is being manually fed by the user for face recognition purpose. The process involves storing of discriminative information about each face in a compact feature vector.

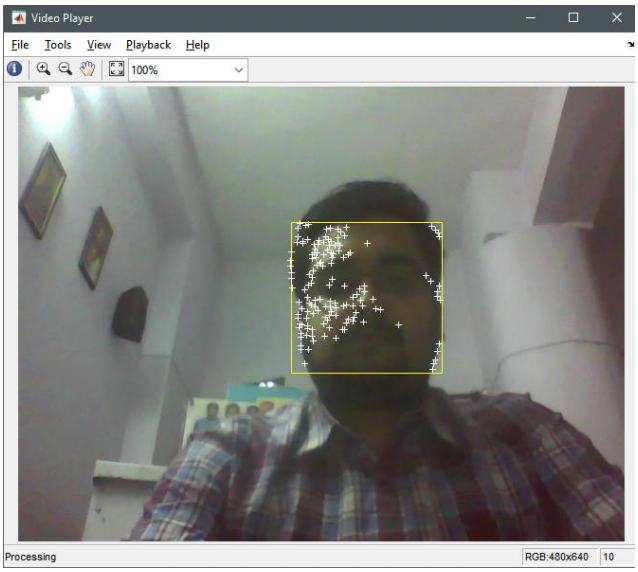

Figure 3. Face Detection

Figure 4. Feature Extraction

In the video captured of students the software takes the input, detects the faces and then extracts the faces out of the video.

C. Face Recognition

The cropped, resized and normalized images of the face after feature extractions are then compared with the database and if matches are found then attendance of those matches are marked.

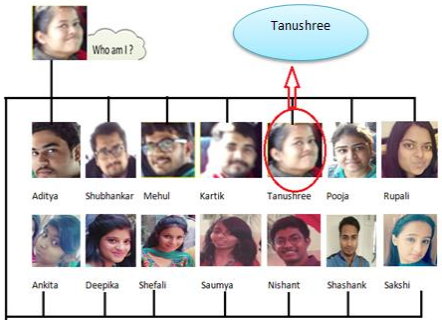

Figure 5. Face Recognition

D. Classifier: ECOC

Error-correcting output coding[4] is a recipe for solving multi-way classification problems. It works in two stages: first, independently construct many subordinate classifiers, each responsible for removing some uncertainty about the correct class of the input; second, apply a voting scheme to decide upon the correct class, given the output of each weak learner. Recent experimental work has shown that ECOC offers improvements over standard k-way classification methods in domains ranging from cloud classification to speech synthesis, and a number of theories have been proposed for its success. The idea of "classifying by consensus" using a large number of independently-constructed classifiers has appeared in a number of other guises recently in the machine learning literature. The technique of bagging, for instance, involves generating multiple training sets by sampling with replacement, learning a classifier from each generated set, and allowing the learned classifiers to vote on the correct class for a unlabelled object.

Design of classifiers using ECOC methods

- Monolithic classifier unit which is composed of a monolithic classifier with multiple outputs, exploiting the decomposition in an implicit way. Examples are multiple-input multiple-output (MIMO) learning machines, such as MIMO[5] MLP (Multi-layer Perceptron) or MIMO decision trees.
- Parallel classifiers unit is implemented by an ensemble of dichotomizers, assigning each dichotomy to a different dichotomizer[6]. Consequently, the learning task is distributed among separated and independent dichotomizers, each learning a different bit of the codeword coding a class.

E. ECOC Approach in Face Recognition

- ✓ Each Class assigned with b-bit binary string (c_i)
- ✓ Uses concept of hamming distance.
- ✓ High Performance

ECOC Algorithm[7]:

Training phase: -

For each $C \times b$ code matrix, (C is the number of classes)

- Codify label of each class with rows of the code matrix.
- Train monolithic classifier with the patterns based on new defined labels.

Therefore, we have a classifier with b output nodes

Test Phase

- Apply an incoming test pattern x to the trained classifier and create an output vector:

$$y = [y_1, y_2, \ldots\ldots, y_n]^T \quad (1)$$

where y_j is the output of jth output node.

For decision making (reconstruction)

- For each class, measure distance between the output vector and label of each class (matrix row):

$$L_i = \sum_{j=1}^{b} |Z_{ij} - y_j| \quad (2)$$

Where Z_{ij} is a member of ith row and jth column in code matrix.

- Assign x to the class j c corresponding to the closest codeword:

$$i = ArgMin(L_i) \quad (3)$$

E. Desired Output

The attendance marking portal will be constantly running on the entry gate computer where an individual can come and mark his/her attendance.

When the portal opens it asks either to mark attendance or register to database.

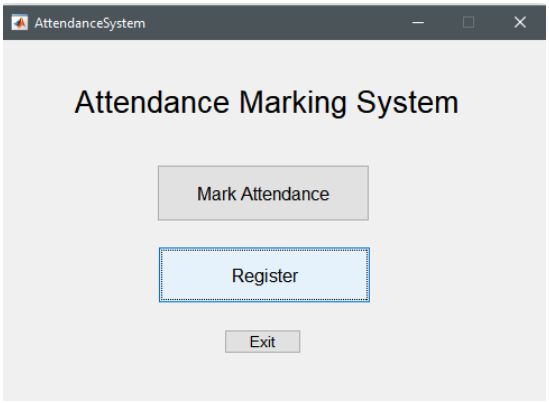

Figure 6. Face Recognition GUI

When all the aforementioned steps are done, the software detects the face, extracts the face and the features and finally compares and recognizes the face with the already present database. This page will be present after the video capturing screen. As a result, after the individual have been correctly identified the software will mark the person's attendance in the database.

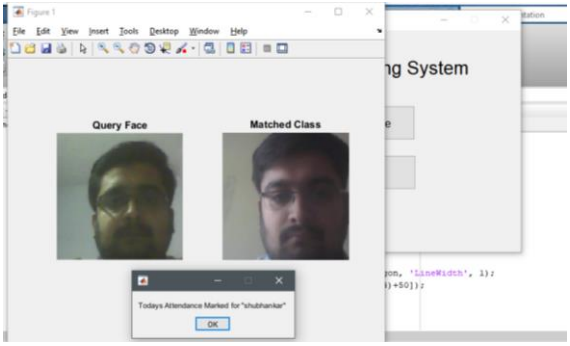

Figure 7. Face Recognition GUI

The results are depicted below:

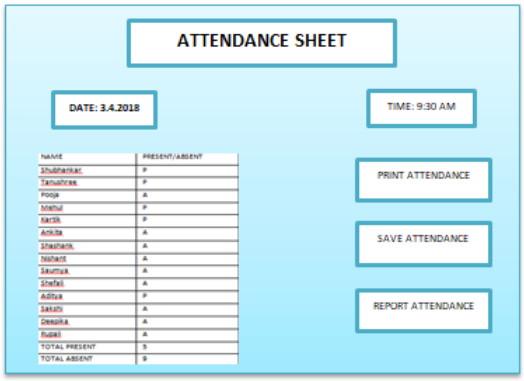

Figure 8. Attendance Review Portal

With the help of such software the procedure of recording attendance becomes easy and reduces complexity of maintaining records.

III. RESULTS

Attendance marking system with the help of face recognition in real time is successfully developed in this research. The software developed is very promising and has a huge database capacity. These kinds of softwares make record maintenance easy and organized. This software can be used while students are in movement as well as while the teachers are in movement. Such softwares can not only be used in colleges but also in organizations where employee's attendance is to be marked and monitored. Places of national importance and high security can also use this software to check intruders and generate alarms.

IV. FUTURE SCOPE

The proposed work can be further extended by increasing the number of parameters (HOG features[8]) used to evaluate and compare the faces. This would further increase the efficiency of the software. The system can be improved by using a wider training set so as to cover a wider range of features and cases of low quality of images. These type of softwares can be used in surveillance cameras of high security areas, for tracking of defaulters in the highway the traffic police can wear glasses with this software embedded in it(like in china), can partially be used as AI(artificial intelligence) for Alzheimer patients etc. Facial Recognition systems have huge and unbounded future scope which needs to be explored. Law enforcement and security uses it to track down criminals. Social media can tag people automatically. Credit card companies will allow you to shop with your face.

V. CONCLUSION

In this paper, we have introduced the training of neural networks with ECOC (Error Correcting Output Codes) classifier for the images which has been extracted out the real time video and we have further extended the same to design a Biometric Attendance Marking System. The classifier was fitted onto the HOG features which were extracted from the training set of the Image Database, which consists of 200 images per person in different orientation and each image has been normalized so as to improve overall efficiency of the system. The facial recognition system is developed in order to compare the maximum differential features amongst the image set. The highlighting factor of the system is that it can detect very minute differences between the images. The system developed has overcome the drawbacks like faulty results due to difference in light intensities, difference in facial expressions and presence of accessories. The maximum accuracy of the system is achieved when the training set's size is larger than the test set and has the ratio 4:1 thus making the system more accurate. The system outperforms the previously existing face recognition systems like BP Algorithm, AFRM (Autonomous Face Recognition Machine) etc. We validated our proposed method on previously mentioned database. The experiment results for different size of test/training sets and HOG feature matrices show the robustness of our proposed method.

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