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STUDENTS ATTENDANCE SYSTEM IN CLASSROOMS USING FACE RECOGNITION SYSTEM

Diksha D. Surkar[1], Nikita S. Hatmode[2], Harsha R. Shende[3] , Nilofer R. Shaikh[4] *Dr.R.M.Tugnayat*

[1]*Diksha D. Surkar,E&TC Department, SSPACE Wardha, Maharashtra, India, dikshasurkar123@email.com*

[2]*Nikita S. Hatmode,E&TC Department, SSPACE Wardha, Maharashtra, India, nikitahatmode26@email.com*

[3]*Harsha R. Shende,E&TC Department, SSPACE Wardha, Maharashtra, India, harshasende12@email.com*

[4]*Nilofer R. Shaikh,E&TC Department, SSPACE Wardha, Maharashtra, India, nilofarshaikh.in@email.com*

5 Dr.R.M.Tugnayat, Principal, ETRX, SSPACE, Wardha , Maharashtra, tugnayatrm@rediffmail.com

Abstract

Human face detection and recognition play important roles in many applications such as video surveillance and face image database management. In our project, we have studied worked on both face recognition and detection techniques and developed algorithms for them. In face recognition the algorithm used is PCA (Principal Component Analysis), MPCA (Multilinear Principal Component Analysis) and LDA (Linear Discriminate Analysis) in which we recognize an unknown test image by comparing it with the known training images stored in the database as well as give information regarding the person recognized. These techniques works well under robust conditions like complex background, different face positions. These algorithms give different rates of accuracy under different conditions as experimentally observed.

In face detection, we have developed an algorithm that can detect human faces from an image. We have taken skin color as a tool for detection. This technique works well for indian faces which have a specific complexion varying under certain range. We have taken real life examples and simulated the algorithms in MATLAB successfully.

Key words: *Face Detection, Face Recognition, Eigen Faces, Cropping, Data base*

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1. Introduction

In traditional face-to-face (F2F) class setting, student attendance record is one of the important issues dealt with any school, college and university from time to time. To keep the student attendance record valid and correct, the faculty staff should have a proper mechanism for verifying and maintaining or managing that attendance record on regular basis. In general, there are two types of student attendance system, i.e. manual attendance system (MAS) and automated attendance system (AAS). By practicing manual recording, faculty staff may experience difficulty in both verifying and maintaining each student's record in classroom environment on regular basis, especially in classes attended by a large number of students. In practice, the manual system also requires more time for recording and calculating the average attendance of each enrolled student. On the other hand, the automated attendance system may offer some benefits to the faculty, at least it may lessen the administrative burden of its staff. Particularly, for attendance system which adopts human face recognition (HFR) technique, such a system commonly involves the process of extracting key features from any facial image of student captured at the time he/she is entering the classroom, or when everybody already occupies his/her seat in the classroom. Upon its successful recognition, it proceeds to marking that recognized student's attendance automatically. Following that general idea, the discussion of this paper is based on the known face recognition techniques in its endeavor to develop a specific computer application which can be used for recognizing any enrolled student automatically from the digital images captured in classroom.

In general, there are two known approaches to HFR, i.e. feature-based and brightness-based approach. The feature based approach uses key point features of the face, such as edges, eyes, nose, mouth, or other special characteristics. Therefore, the calculation process only covers some parts of the given image that have been extracted previously. On the other hand, the brightness-based approach calculates all parts of the given image. It is also known as holistic-based or image-based approach.

Maintenance of student attendance is the most difficult task in various institutions. Every institution has its own method of taking attendance such as using attendance sheet or by using some biometric methods. But these methods consumes a lot of time.

2. Block Diagram

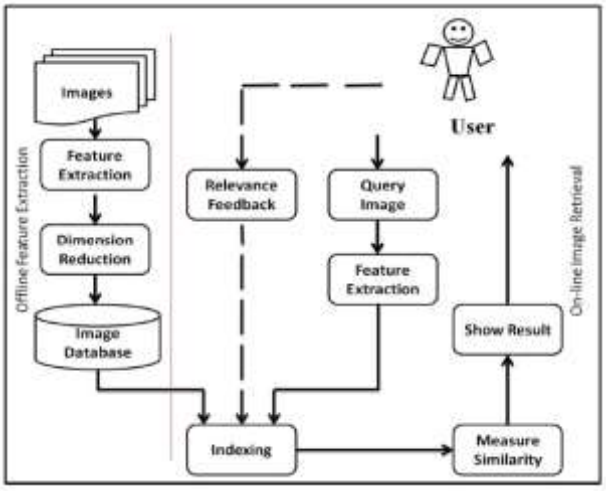

Fig.2Block diagram

Description of Block Diagram

In off-line stage, the system automatically extracts visual attributes (color, shape, texture, and spatial information) of each image in the database based on its pixel values and stores them in a different database within the system called a feature database. The feature data (also known as image signature) for each of the visual attributes of each image is very much smaller in size compared to the image data, thus the feature database contains an abstraction (compact form) of the images in the image database. One advantage of a signature over the original pixel values is the significant compression of image representation However, a more important reason for using the signature is to gain an improved correlation between image representation and visual semantics

I) Query image

It is the image to be found in the image database, whether the similar image is present or not. And how many are similar kind images are exist or not.

II) Image database

It consists of n number of images depends on the user choice.

III) Feature extraction

The color images are having the standard Color is RGB color. Color histograms are commonly use content based image retrieval. Feature means characteristics of object. Feature extraction is refers that dimensionality reduction of that object. It plays an important role in image processing. Features are classified into three types in image processing, that is low, middle and high. Low level features are color, texture and middle level feature is shape and high level feature is semantic gap of objects.

IV) Image matching

The information about each image is stored in its feature vector for computation process and these feature vectors are compared with the feature vectors of query image which helps in measuring the similarity.

V) Resultant retrieved images

It finds the previously maintained information to find the matched images from database. The output will be the similar images having same or closest features as that of the query image.

VI) Relevance Feedback

CBIR use the visual contents which are extracted from the images to search the similar images from the large database. For this task “Semantic Gap” the problem facing by the user and to overcome this ’Relevance feedback is introduced. The main idea behind the relevance feedback is to get the results from the very first initial query which is given by the user and further use that information, whether the results are relevant or irrelevant.

3 Algorithm

This section describes the software algorithm for the system. The algorithm consist of the following steps

- Image acquisition
- Histogram normalization
- Noise removal
- Skin classification
- Face detection
- Face recognition
- Attendance

Fig.3 Algorithm for Attendance System

I) Image Acquisition

Image is acquired from a high definition camera that is connected above the white board. This camera is connected to the computer. It captures images after every 2 minutes and sends these images to the computer for processing. Figure 2 shows the input image of classroom captured by the camera.

II) Histogram Normalization

Captured image sometimes have brightness or darkness in it which should be removed for good results. First the RGB image is converted to the gray scale image for enhancement. Histogram of Input Image Histogram normalization is good technique for contrast enhancement in the spatial domain.

III) Noise Filtering

Many sources of noise may exist in the input image when captured from the camera. There are many techniques for noise removal. Low pass filtering in the frequency domain may be a good choice but this also removes some important information in the image. In our system median filtering in is used for the purpose of noise removal in the histogram normalized image.

IV) Skin classification

This is used to increase the efficiency of the face detection algorithm. Voila and Jones is used for detection and its accuracy can be increased if the skin is classified before the scanning procedure of faces. Pixel those are closely related to the skin becomes white and all other are black. This binary image uses the thresholding of skin colors.

V) Face Detection

Face detection is a computer technology being used in a variety of applications that identifies human faces in digital images. Face detection also refers to the psychological process by which humans locate and attend to faces in a visual scene.

VI) Face Recognition

The face recognition algorithms used here are Principal Component Analysis (PCA), Multilinear Principal Component Analysis (MPCA) and Linear Discriminant Analysis (LDA). Every algorithm has its own advantage. While PCA is the most simple and fast algorithm, MPCA and LDA which have been applied together as a single algorithm named MPCALDA provide better results under complex circumstances like face position, luminance variation etc. Each of them have been discussed one by one below.

VII) The Eigen Face Approach

In the language of information theory, the relevant information in a face needs to be extracted, encoded efficiently and one face encoding is compared with the similarly encoded database. The trick behind extracting such kind of information is to capture as many variations as possible from the set of training images.

Mathematically, the principal components of the distribution of faces are found out using the eigen face approach. First the eigenvectors of the covariance matrix of the set of face images is found out and then they are sorted according to their corresponding eigen values. Then a threshold eigen value is taken into account and eigenvectors with eigen values less than that threshold values are discarded. So ultimately the eigenvectors having the most significant eigen values are selected. Then the set of face images are projected into the significant eigenvectors to obtain a set called eigen faces. Every face has a contribution to the eigen faces obtained. The best M eigen faces from a M dimensional subspace is called "face space"

Each individual face can be represented exactly as the linear combination of "eigen faces" or each face can also be approximated using those significant eigen faces obtained using the most significant eigen values.

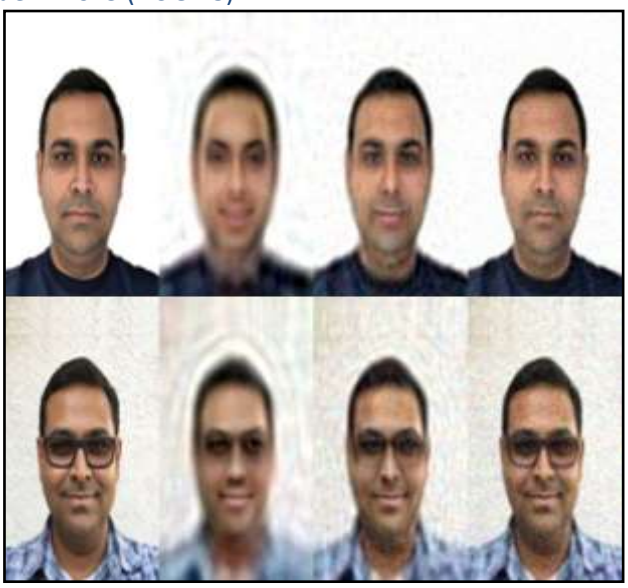

Fig.3.1 Eigen Faces

4. MATLAB

4.1 Overview

MATLAB (matrix laboratory) is a multi paradigm numerical computing environment. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipul-tions, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python.

Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the Mu PAD symbolic engine, allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

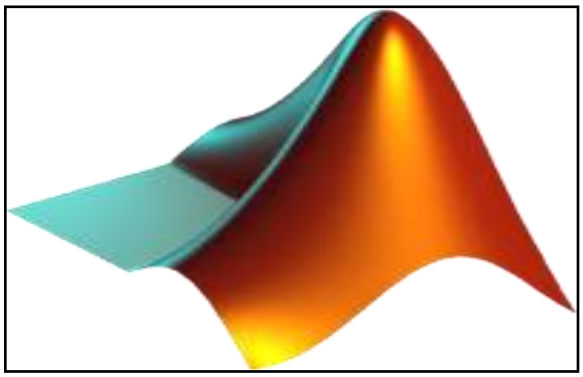

Fig.4 MATLAB

II. MATLAB Toolboxes

MATLAB toolboxes used in this system are as follows:

a) Image Acquisition Toolbox.
b) Image Processing Toolbox.

a) Image Acquisition Toolbox

Image Acquisition Toolbox is a collection of functions that extend the capability of the MATLAB numeric computing environment. The toolbox supports a wide range of image acquisition operations, including.

- Acquiring images through many types of image acquisition devices, from professional grade frame grabbers to USB-based Webcam.
- Triggering acquisitions (includes external hardware triggers)
- Configuring callback functions that execute when certain events occur
- Bringing the image data into the MATLAB workspace.

5. GUI (Graphical User Interface)

I. Overview

A GUI uses a combination of technologies and devices to provide a platform the user can interact with, for the tasks of gathering and producing information.

A graphical user interface (GUI) is a type of user interface that offers graphical icons and visual indicators, as opposed to text-based interfaces, typed command labels or text navigation to fully represent the information and actions available to a user. The actions are usually performed through direct manipulation of the graphical elements.

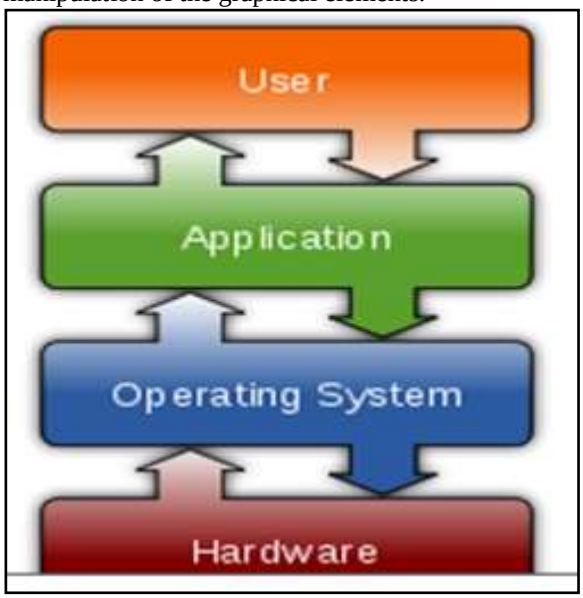

Fig. 5 GUI Structure

II. Why use GUI in MATLAB?

The main reason GUI are used is because it makes things simple for the end users of the program. If GUIs are not used, people would have to work from the command line interface, which can be extremely difficult and frustrating. MATLAB is one of the best tools to make GUI in a simplest manner. GUI is widely used in hand-held devices such as MP3 Players, Portable Media Players or Gaming devices,

household appliances and office equipment with images rather than text commands.

6. Logitech Webcam C170

Smoother, Sharper, Clearer, Richer. Logitech Fluid Crystal Technology. It is what makes a Logitech webcam better. It is sharper pictures, smoother video, richer colours and clearer sound in real-world conditions.

Fig.6 Webcam

7. Product Information

a) Brands : Logitech
b) Model : C170
c) Interface Type : Hi-Speed USB
d) Max Video Resolution : 1024 x 768
e) Type : Webcam C170
f) Packaged Quantity : 1
g) Product Line : Logitech Webcam
h) Camera Type (Video Input) : Web camera
i) Secondary Audio Program (SAP) : Yes
j) Microsoft Certification : Compatible with Windows 7
k) Warranty : 2 years warranty
l) Compatibility : PC
m) EAN : 5099206027886
n) Colour : Black

8. Result Analysis

Here to show the result of the student attendance system we design a GUI in MATLAB software that shows the following result of the project. The following figure shows the designed GUI for face recognition of student

Fig.8 Recognized student face

9. Conclusion

There may be various types of lighting conditions, seating arrangements and environments in various classrooms. Most of these conditions have been tested on the system and system has shown 100% accuracy for most of the cases. There may also exist students portraying various facial expressions, varying hair styles, beard, spectacles etc. All of these cases are considered and tested to obtain a high level of accuracy and efficiency. Thus, it can be concluded from the above discussion that a reliable, secure, fast and an efficient system has been developed replacing a manual and unreliable system. This system can be implemented for better results regarding the management of attendance and leaves. The system will save time, reduce the amount of work the administration has to do and will replace the stationery material with electronic apparatus and reduces the amount of human resource required for the purpose. Hence a system with expected results has been developed but there is still some room for improvement.

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