AN AUTOMATED STUDENT ATTENDANCE REGISTERING SYSTEM USING FACE RECOGNITION

A THESIS SUBMITTED IN PARTIAL FULFULMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Bachelor in Technology
In
Electronics and instrumentation Engineering

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DECLARATION

I declare that the project work with the title **"AN AUTOMATED STUDENT ATTENDANCE REGISTERING SYSTEM USING FACE RECOGNITION**" is my original work done under Prof. SUKADEV MEHER, National Institute of Technology, Rourkela. I have learned and followed all the rules and regulations provided by the Institute while writing this thesis. I have tested the plagiarism, which is below 20 percent in similarity. This project work is being submitted in the fulfillment of the requirements for the degree of Bachelor of Technology in Electronics and Instrumentation Engineering at National Institute of Technology, Rourkela for the academic session 2011– 2015.

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May 11, 2015

CERTIFICATE

This is to certify that the thesis titled "**AN AUTOMATED STUDENT ATTENDANCE REGISTERING SYSTEM USING FACE RECOGNITION**" submitted by Himanshu Mallik (Roll no: 111EI0249) in partial fulfillment of the requirements for the award of Bachelor of Technology Degree in Electronics and Instrumentation engineering at National Institute of Technology, Rourkela is an authentic work carried out by him under my supervision and guidance.

Prof. Sukadev Meher

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ABSTRACT

Uniqueness or individuality of an individual is his face. In this project face of an individual is used for the purpose of attendance making automatically. Attendance of the student is very important for every college, universities and school. Conventional methodology for taking attendance is by calling the name or roll number of the student and the attendance is recorded. Time consumption for this purpose is an important point of concern. Assume that the duration for one subject is around 60 minutes or 1 hour & to record attendance takes 5 to 10 minutes. For every tutor this is consumption of time. To stay away from these losses, an automatic process is used in this project which is based on image processing. In this project face detection and face recognition is used. Face detection is used to locate the position of face region and face recognition is used for marking the understudy's attendance. The database of all the students in the class is stored and when the face of the individual student matches with one of the faces stored in the database then the attendance is recorded.

INTRODUCTION

Attendance is prime important for both the teacher and student of an educational organization. So it is very important to keep record of the attendance. The problem arises when we think about the traditional process of taking attendance in class room. Calling name or roll number of the student for attendance is not only a problem of time consumption but also it needs energy. So an automatic attendance system can solve all above problems.

There are some automatic attendances making system which are currently used by much institution. One of such system is biometric technique. Although it is automatic and a step ahead of traditional method it fails to meet the time constraint. The student has to wait in queue for giving attendance, which is time taking.

This project introduces an involuntary attendance marking system, devoid of any kind of interference with the normal teaching procedure. The system can be also implemented during exam sessions or in other teaching activities where attendance is highly essential. This system eliminates classical student identification such as calling name of the student, or checking respective identification cards of the student, which can not only interfere with the ongoing teaching process, but also can be stressful for students during examination sessions.

Flow chart:

```
                    ┌──────────────┐
                    │    Start     │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │ Input image  │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │  Histogram   │
                    │ equalisation │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │    Noise     │
                    │   removal    │
                    └──────┬───────┘
                           ▼
                    ┌──────────────────┐
                    │ skin classification│
                    └──────┬───────────┘
                           ▼
        ┌──────────────────┐          ┌──────────────┐
        │  Face detection  │────────▶ │  Attendance  │
        └──────┬───────────┘          │   Database   │
               ▼                       └──────────────┘
        ┌──────────────────┐          ┌──────────────┐
        │ Face recognition │────────▶ │ Face database│
        └──────┬───────────┘          └──────────────┘
               ▼
            ◇ If
          any attendance
            missing ◇ ─────────── YES
               │
               ▼ NO
        ┌──────────────┐
        │     End      │
        └──────────────┘
```
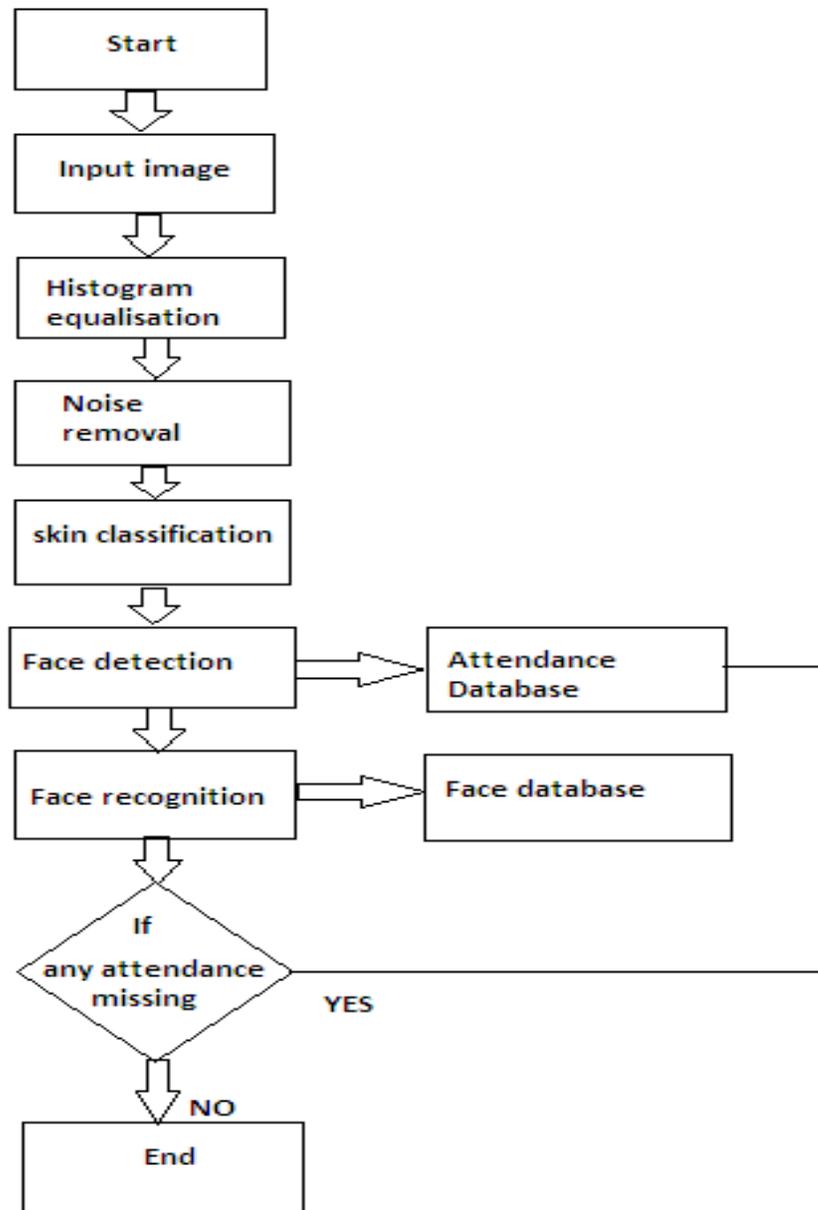
Chapter 2
Face detection

1. Introduction

Face detection is defined as finding the position of the face of an individual. In other word it can be defined as locating the face region in an image. After detecting the face of human its facial features is extracted and has wide range of application like facial expression recognition, face recognition, observation systems, human PC interface and so forth…Detecting face in an image of single person is easy but when we consider a group image of an image containing multiple faces, the task becomes difficult.

For the application of face recognition, detection of face is very important and the first step. After detecting face the face recognition algorithm can only be functional. Face detection itself involves some complexities for example surroundings, postures, enlightenment etc.

There are some existing methodologies for detection of face. Some of them are skin color based, characteristic or feature based (feature like mouth, nose and eyes) and neural network based. Among the above techniques, the skin based procedure is well thought-out as simplest one. The approach premeditated and applied in this thesis is the skin color based face detection method. The algorithm is pretty dynamic as numerous people face can be detected at one time from an image containing many people. In this project YCbCr color model is used to detect the skin of human being.

2. Segmentation based on color

The Segmentation can be defined as the conception of subdividing a given image into its constituent region. Segmentation based on the color of skin is picking up its supremacy in current time. Skin based segmentation is being studied for the reason that of its dynamic research in content- based picture illustration. In the case of face detection, segmentation is used to find locate the face boundary of face region in an image. Once the face region is found, we can apply various processing like image editing, various coding, and image indexing and client intuitiveness intention. Moreover, face detection is the first step required for the purpose of recognition of face and its expression using various processes. Color of Skin of an individual depends on various biochemical components like the melanin content, pigmentation of skin and much more. The skin color is belongs to certain range in the total color space. Consideration should be taken into account that the skin should not be abnormal. Used algorithm in this project takes the benefit of face color association to limit the face search to areas of an input image that have at least the accurate color components. There are many existing algorithm for segmentation but used algorithm is the simplest one.

A. RGB Color Space

Red, green, blue are the three color component that constitute the RGB color space. These red, green, and blue colors combine in a definite proportion to yield a different color. RGB color model can be represented by a 3-dimentional cube with the three colors at the corner of the cube and in each axis as shown in Figure. At the origin of this cube black color is present. White color is present at the opposite corner of the 3-dimesional cube i.e., at the opposite diagonal of the cube. Gray color scale is represented by the line from black color at the origin to the white color at opposite corner. Red is (255, 0, 0) when we consider a 24-bit color graphics system with a color bit of 8-bit per color channel. When we consider the 3-dimensional color cube, red is at (1, 0, 0). This model simplifies the design of the pc graphics frameworks yet is not perfect for all

type of application applications. These three color component are very closely related to each other, which makes it hard to implement some of the algorithm for image processing.
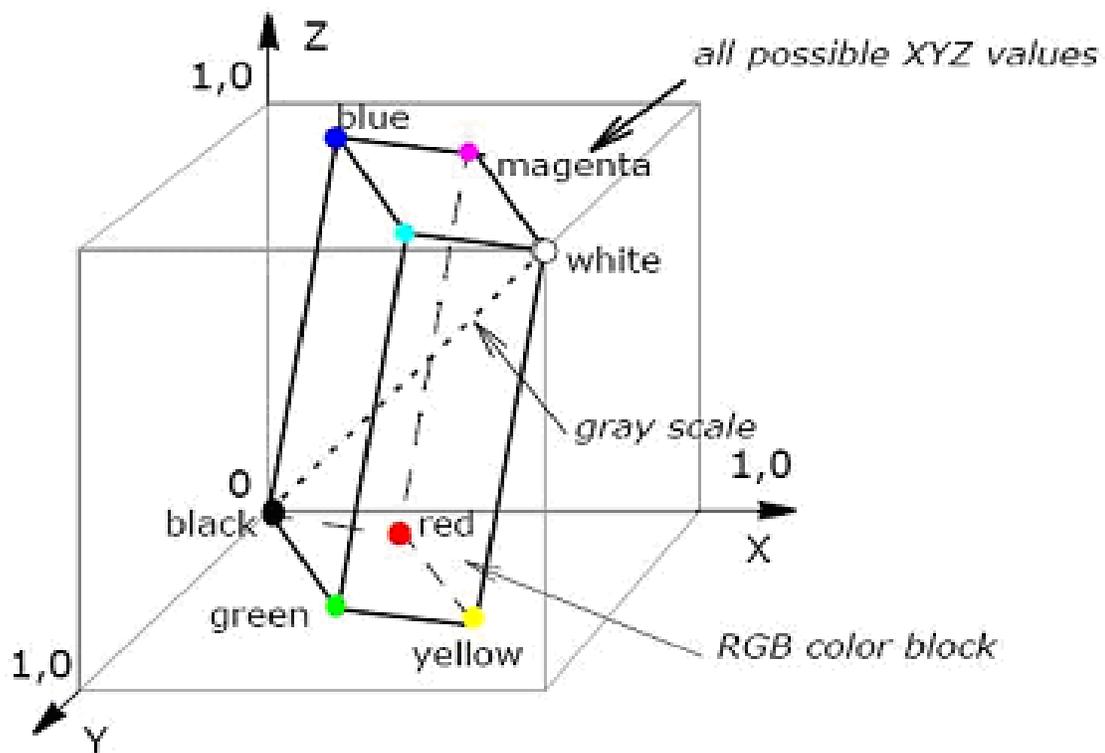

Figure 1 3-dimensional RGB color space

B. HSV Color Model

There are some problems which are associated with the RGB color space model. One important issue connected with RGB is that it doesn't consider the effect of light on the color of skin, which generally cause some wrong in turn. This problem can we solved by using HSV model for skin color. Here H stand for hue which is depth of color, S stand for saturation or the purity of color and V stand for the value of intensity of light or the brightness of color. The model is shown in figure.

The red, blue and yellow color is represented by hue and which has the range from 0 to 360^0. While using HSV color space we don't need the information of the proportion of blue and green color needed to produce a different color. Only thing needed is that by altering the hue we can get the desired color of our interest. The purity of the color is represented by the saturation value, which has the range of 0 to 100%. Lets take an example of getting pink color from that of the dark red color, which can be done by simply modifying the saturation value .value gives idea about the brightness of the given color and it gives the achromatic thought of the given color. The range of value extend from zero to hundred. 'H' and 'S' gives the required information about the color of skin. The pixel value of skin color should satisfy the below condition in order to consider that as skin.

"0 <= H <= 0.25" and " 0.15 <= S <= 0.9;"
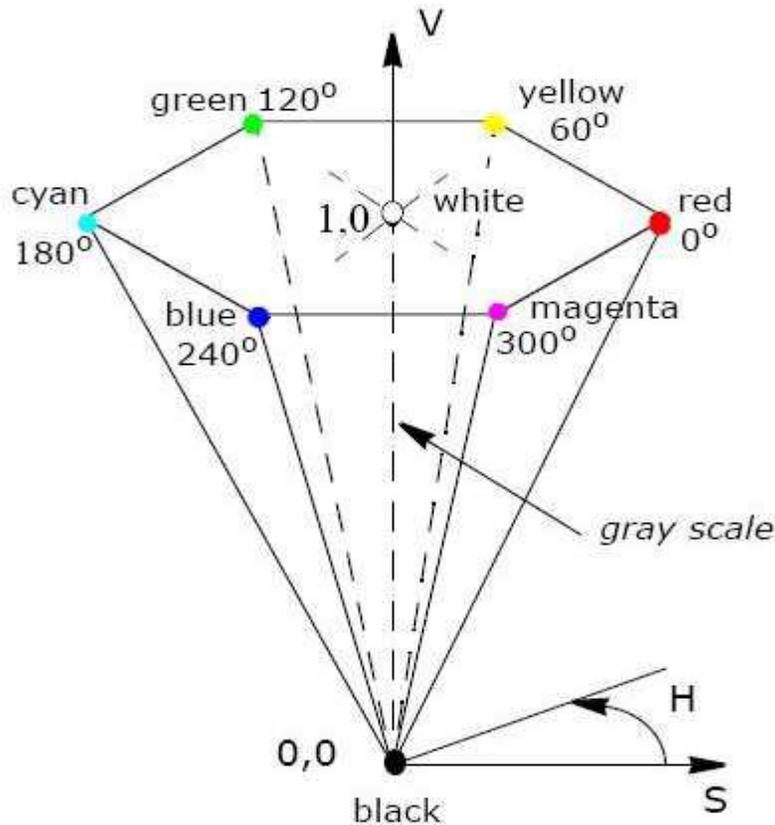
Figure 2 Model of HSV Color Space for Skin

C. YCbCr Color Model

This color model has more advantage than the upper two model as discussed above and it uses the chrominance value to extract the skin color region of an given image. 'YCbCr' or 'Y'CbCr' color space are generally used in the digital image processing. Y is the luminance, luma component is represented by Y' while Cb and Cr are the blue difference and red difference of the chroma component respectively. YCbCr is not a real color space. This is just another way of encoding the RGB color space. The YCbCr values can only be obtained only if the original RGB information of the image is available.

$$\text{``}Y = 0.299R + 0.587G + 0.114B$$
$$Cb = -0.169R - 0.332G + 0.500B$$
$$Cr = 0.500R - 0.419G - 0.081B\text{''}$$
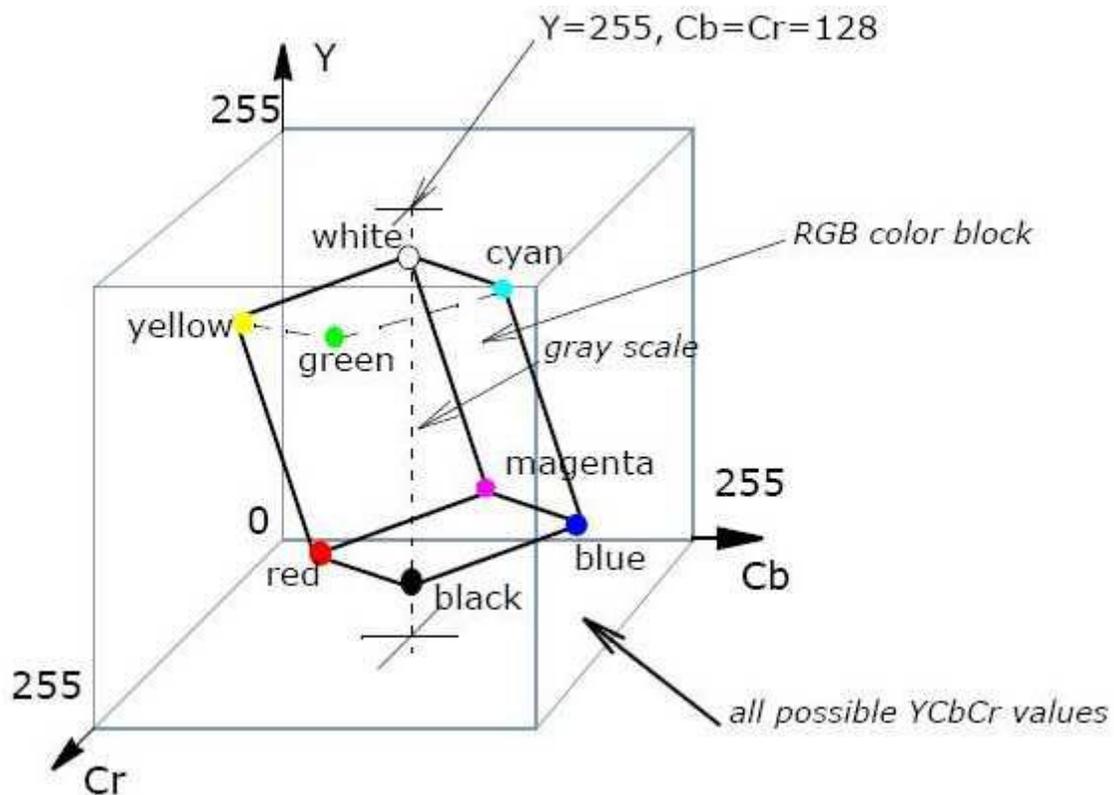
Figure 3 YCbCr color space for skin tone

3. PROPOSED APPROACH

Here I have described the algorithm that I have used for the purpose of face detection. The algorithm is the combination of RGB and HSV algorithm. The efficiency of the proposed algorithm is more when single face in a given image is taken into consideration. In case of no of face more than one in an image, the acquired input image may result in detection of some false face. The steps of the algorithm is discussed as follows

STEP1: **(Acquisition of the input image)**

The input image can be acquired using a variety of conduct for example we can take the image by using camera directly or we can take the image from the stored database folder. The second way is more effectual as the debugging process becomes much faster. An acquired image is shown in the below figure.

Figure 4 Acquired input image

STEP 2: (Extraction of the skin type using HSV color space)

In this algorithm the HSV color model is used which consider the effect of light. In MATLAB 'rgb2hsv' command is used to get the HSV image from that of the RGB image. Later than that each of the three H,S,V component is extracted and the extracted image gives information for the color of skin . A pixel whose H and S component satisfies the equation

$$0<=H<=0.25; 0.15<=S<=0.9;$$

Is considered as a pixel in the individual. In Figure 5 the HSV color space image is shown and in figure 7 the extracted skin color image is shown.
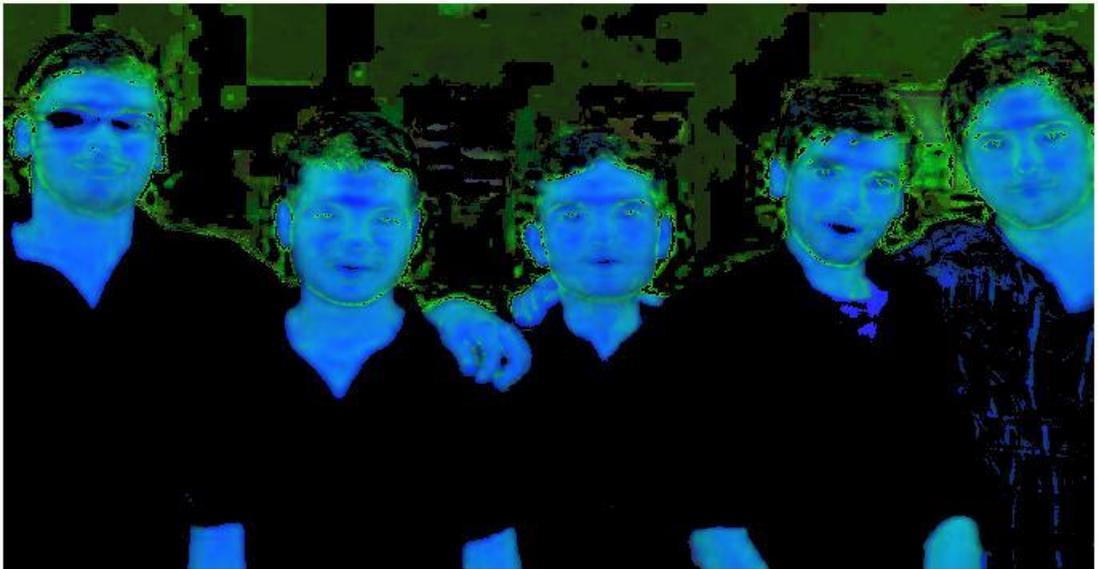
Figure 5 HSV Colour Space Image

Figure 6 Extracted skin colour Image

STEP 3 (output image is transferred to the rgb color and produce binary image based on the value of R, G and B)

After getting the skin color region the image is converted into the RGB image i.e, only the skin color region is converted. Next the R,G,B value is extracted by assigning the value of the three channels into three variables. If the R,G,B value of the pixel satisfies the below equation then it will classified as skin.

$$\text{``R>95 and G>40 and B>20 and max(R,G,B)-min(R,G,B)}$$
$$\text{and } |R-G|>15 \text{ and R>G and R>B''.}$$

If the pixel satisfied condition will become white else it will be of black color as shown in the Figure 5.
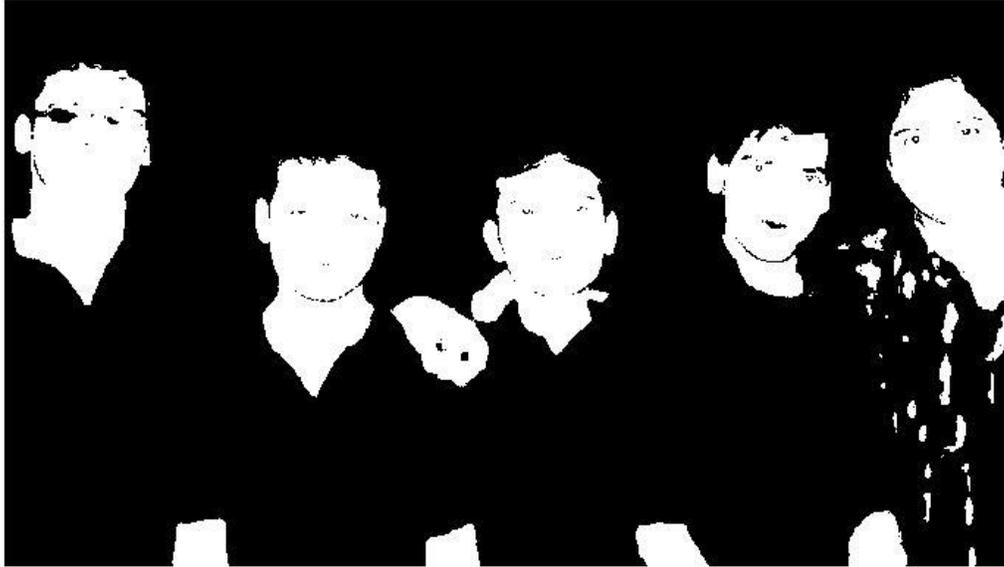
Figure 7 Binary image produced from the RGB image

STEP4 filling of black dot inside the white region.

 The converted binary image contains black spot, and that can create problem in next processing. To fill the black spot I used the 'imfill' command of MATLAB. The resulting image is shown in figure 7.
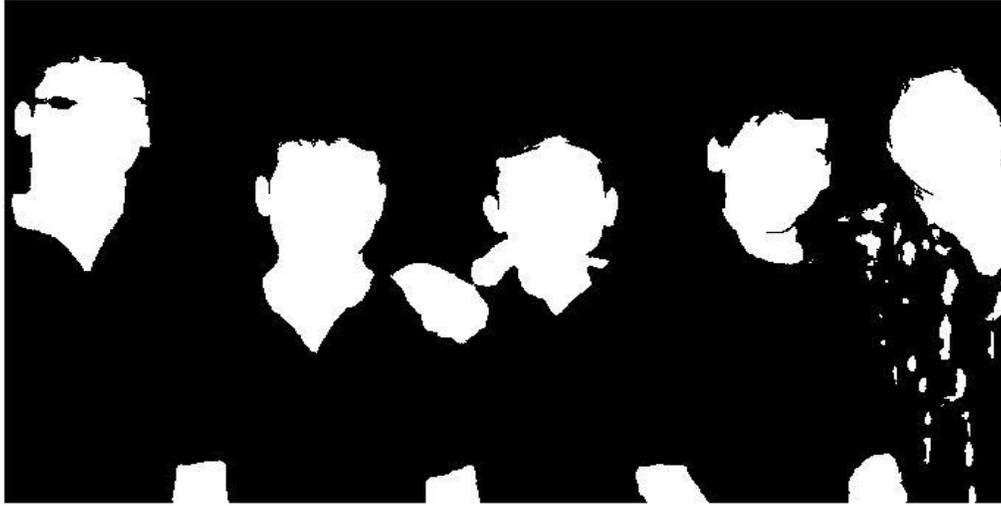
Figure 8 Image after removal of the black dots

STEP 5: morphological operation is done to remove the small areas which are very small to be a face.

This step is the most critical and additionally the best module in the entire face identification process. As expressed before, the algorithm based on skin color , if other exposed part of the body is more than the pixel value of the face region than it will create problem. Figure 8 shows the small exposed body part i.e, other than face is removed.
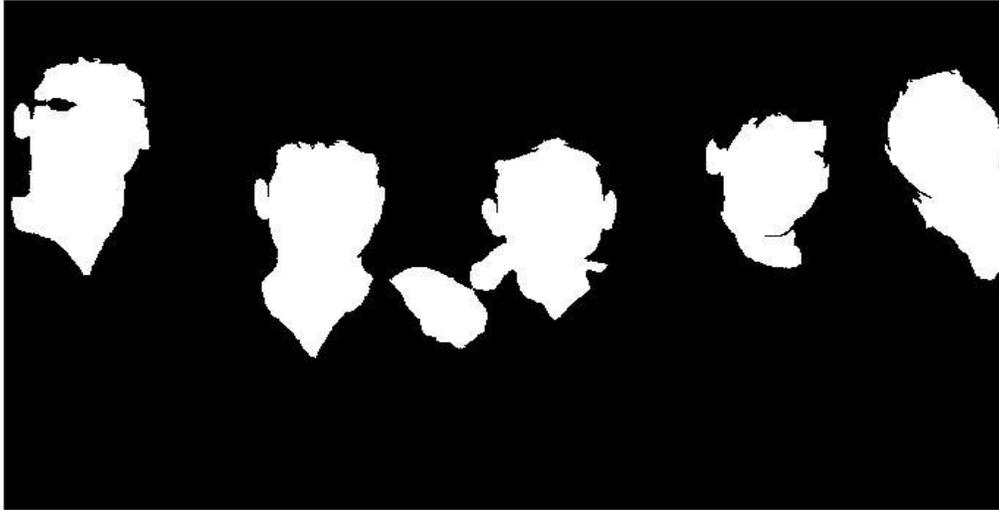
Figure 9 Binary Image with the removed small exposed body region

Step6: (drawing bounding box around each face region)

"bwboundaries" command is used to get the boundary around the detected face. In the below figure it is shown with green color rectangular boundary.
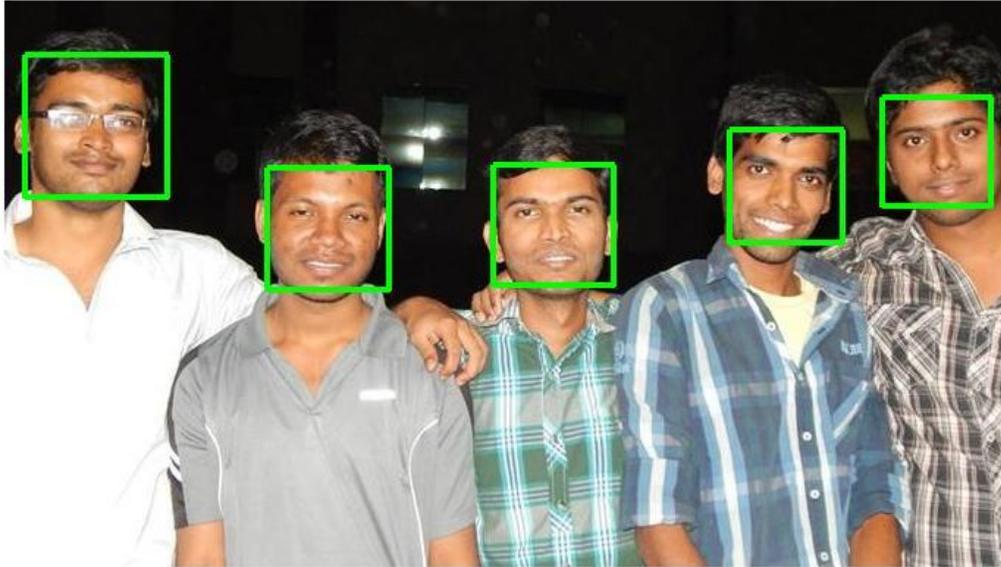
Figure 10 Image showing detected face region bounded by the rectangular box

Chapter 3
Face recognition

1. Introduction

The recognition of face of human is challenging in computer-human interaction. The face is our essential center of consideration in societal life playing a critical part in assigning identification and emotion of the person. We can perceive various appearances adapted all through our lifespan and distinguish faces initially even following quite a while of detachment. This expertise is very vigorous notwithstanding of substantial varieties in visual boost because of evolving condition, maturing and diversions, for example, facial hair, glasses or changes in haircut.

Computational models of face acknowledgment are fascinating in light of the fact that they can contribute to hypothetical learning as well as to functional applications. PCs that identify and recognizes the face could be connected to a broad assortment of undertakings together with criminal recognizable proof, security framework, image and film handling, identity confirmation and human-PC interaction. Tragically, adding to a computational model of face recognition and acknowledgment is very troublesome in light of the fact that faces are perplexing, multidimensional and important visual stimuli.

This project uses the principal component analysis (PCA) for face recognition. There are many other face recognition algorithm, but principal component analysis (PCA) based face recognition is the simplest one for face recognition

2. Principal Component Analysis (PCA)

PCA was invented by Karl Pearson in 1901. It involves the mathematical method to transforms an amount of probably interrelated variables into a numeral of unorganized variables is called the principal components, related to original variables by an orthogonal transformation. The transformation can be defined as that the first principal component has as high variance as   it is possible and for every succeeding component thus has the highest variance conceivable under the imperative that it be orthogonal to the former components.

3. Steps Used in PCA Algorithm

Step1: Acquire training set of 'N' number of images at the initial stage. In this project the images are of 92*112 pixels each. Training set is shown in the figure.

Step2: Calculation of the eigenface from the "N" training set images keeping only few M images that is correspond to that of the highest eigen values. The M images describe the "face space". When new faces encountered, the "eigenfaces" can be recalculated accordingly.

Step3: The corresponding distribution of the "M" dimensional weight space for every known individual is Calculated by projecting their respective face images onto "face space".

Step 4: Compute set of the weights anticipating or projecting the data picture or input image to M "eigen faces".

Step5: Determine if the given image is face image or not by checking to the closeness of given image or picture to "face space".

Step 6: If the image is sufficiently close enough, then classify the weight pattern as either an unknown or as a known person based on measured Euclidean distance.

Step7: If the image is sufficiently close enough then refer to the recognition is successful and give applicable information about recognized face from the database which hold data of faces.
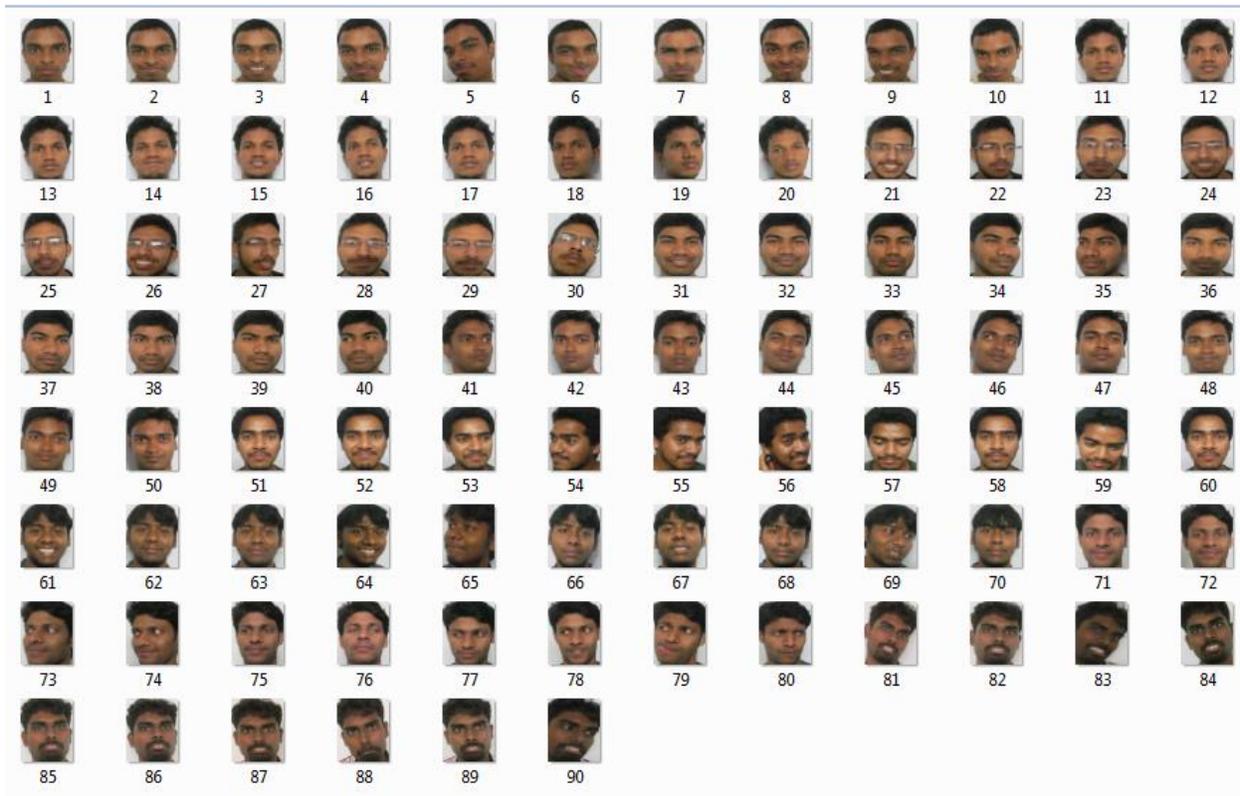

**Figure 11 Showing the Images of the Training Set**

Recognizing an unknown face

Input image of
UNKNOWN FACE → Convert the input image to a face vector → Normalize the face vector

↓

Project Normalized face onto the eigenspace

↓

$$\Omega= \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_k \end{bmatrix}$$

Weight vector of input image

←

Calculate Distance between input weight vector and all the weight vector of training set
$$d=|\Omega-\Omega i|^2$$

↑

Is Distance d> threshold

RECOGNIZED AS…….. ← **YES**

NO → UNKNOWN FACE
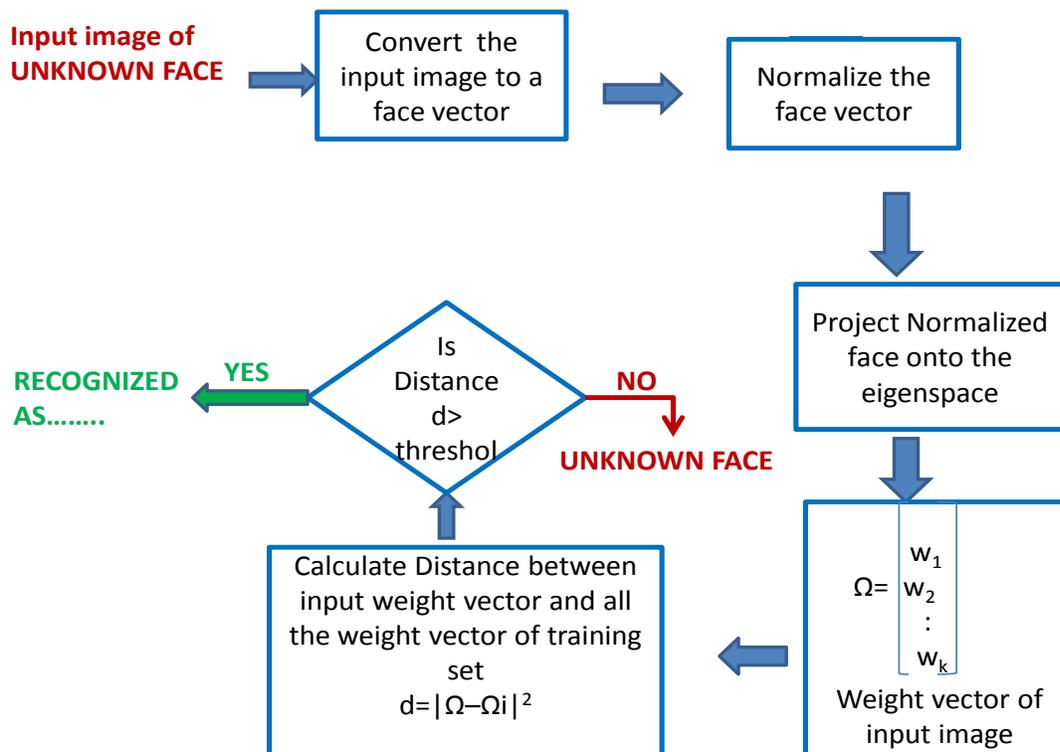
Figure 12   Flow chart of the algorithm

4. Mathematical Approach

Let I1, I2... Im be the 'M' set of train images.

The Average face of set can be defined as

$$\text{'A'} = (1/\text{M})*\sum_{N=1}^{M}(I_N)$$

Individual face difference from the average face is given by

$$\Phi_i = I_i\text{-A}$$

When it is subjected to principal component analysis (PCA), the large set of vectors seeks a set of M orthogonal vectors **Un**, which best describes the distribution of data.

The *k*th vector **Uk** is chosen such that

$$\lambda_K = (1/M) \ \sum_{N=1}^{M}[(U_K)^T * \Phi_N]^2$$

is maximum, subject to

$$(U_I)^T U_K = \delta lk \quad = \begin{cases} 1, & if \ l = k \\ 0, & otherwise \end{cases}$$

The vector U_k and the scalar λ_k are the eigen vectors and eigen values respectively of the covariance matrix

$$C = (1/M)\sum_{N=1}^{M}(\Phi)(\Phi)'$$

$$C = B*B'$$

Where the matrix

$$B = [\Phi_1 \Phi_{2\dots} \ \Phi_M]$$

5. EXPERIMENTAL ANALYSIS

The database or training set of NIT Rourkela student is created. The data base contain photo of nine students. Each student having ten images so the total image is equals to 90. The training set is shown in figure 10.each image is of 92×112 pixel.

The test image set consists of ten images of the nine students. The image in the test set is different i.e. they are not taken from the database. The test set can be shown in figure   as follows.
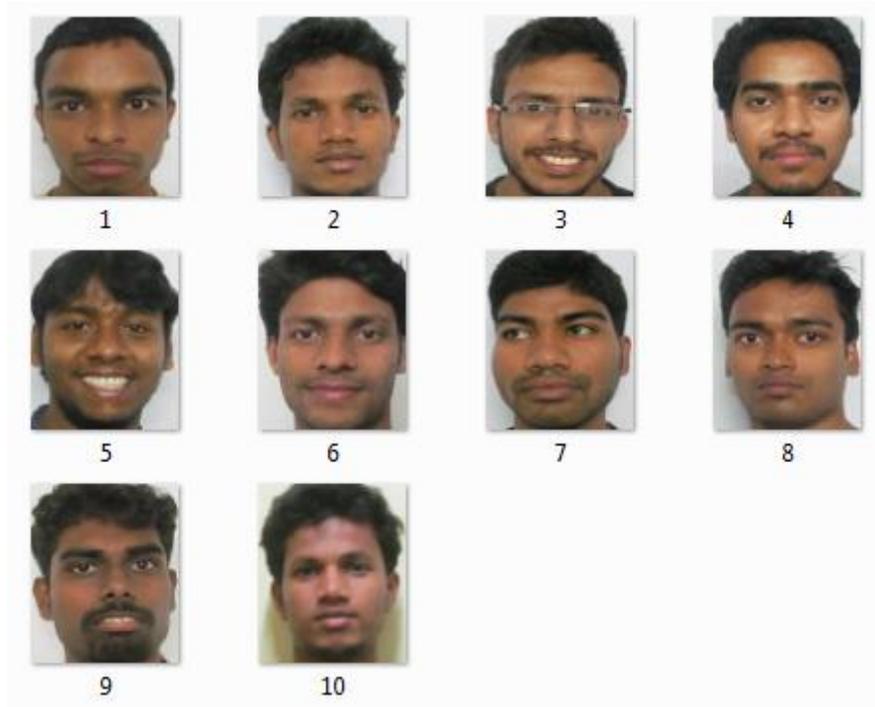
Figure 13 Training Set Images

6. Experimental Results

When an input image is given , which is not present in the data base , the input image is processed and the best matching i.e, where the elucidance distance is less that image is considered as the recognized image. The experimental result is shown in figure. Where the recognized image is 16th image from the database and the recognized image is himanshu , which is shown in the command window of the MATLAB.

```
the recognized image is :16.jpg
Himanshu
     16
```
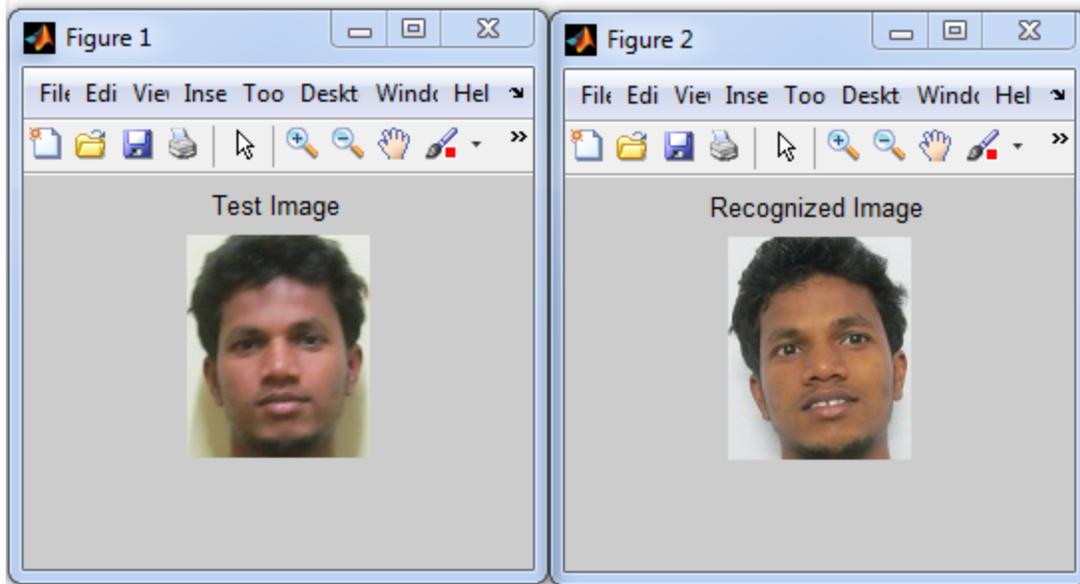

Figure 14 Showing the Input and Output Images

Chapter 4
Attendance Registering

1. Introduction

Class attendance is very important aspects for the students studying in the colleges or schools. For an organization to be successful, it needs precise and quick method for recording the performance of the individuals inside this organization. Attendance gives the data of the individual whether that particular person is physically present or absent. The traditional method of calling roll number or name of the student for marking attendance is time consuming or wastage of time during the class hour.

In this project an automated student attendance system is made, which is based on face recognition. The recognized face of the individual is used for marking the attendance.

2. Creating Attendance Sheet

As the database contain images of nine students, so the attendance sheet should contain name of the nine students. The 9×1 cell array is created which contain the name of the nine student as shown in the figure.

Figure 15 Showing the Name of the Student is stored in the Cell

3. Marking Attendance of the Student

When the face of the particular student is recognized, attendance is marked for that student for that particular day. If some students are absent then no attendance is marked for them. For attendance marking logic 1 is written. in the 9×1 cell each cell contain name of the student, and attendance is marked for the student shown in figure15. The attendance sheet is stored in the variable name data. Consider the second name stored in the cell array i.e, himanshu. When himanshu is recognized for lets say five times i.e, one in each day then attendance is marked five times for that particular student. The particular case is shown in figure 16. Like this other student attendance is marked according to their presence in that particular day.

Figure 16 Attendance Sheet Showing Marked Attendance

In Figure 16 first row showing 1×3 cell, which means the particular student is present for 2 days. The first column is used for storing the name of the student and so the next two column is used for marking the attendance. Similarly the same is applicable for other raw of the 9×1 cell. Take another example of raw no 2, which is showing 2×5 cell, which means that particular student is present for 4 days. The marked attendance of the student in the second raw cell is shown in Figure 17.

Figure 17 Showing Marked Attendance for the Student

Chapter 5
Conclusion

1. Conclusion

The face detection and recognition algorithms were studied thoroughly taking number of the test from different varying condition images. For face detection combination of RGB and HSV model algorithm is used. For face recognition principal component analysis method is used. Attendance of the student are marked using the recognized face of every individual student and the data is stored in an attendance sheet. The attendance of every student marked automatically by recognizing their face with the face present in the data base.

2. Future Work

Further work can be done on this project to alert the student by sending SMS regarding the attendance. For this purpose GSM module can be used. SMS alert can be given to the parent of the student.

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