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# Efficient Face Segmentation for Recognition in Group Photographs

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**Abstract: Group photograph has a critical issues like size and partial images. The most difficult challenge is to detect faces in clumsier group photos. Many algorithms are available to identify the individual images from image data bases of good quality images with proper image information density. There is a strong requirement to identify faces from group photographs. Our work presents an interactive algorithm segment out and recognize a person's face from a group photograph. The method involves a fast, reliable, and effective algorithm that will recognize the faces present in the group photo. Also analysis has done to determine the effect of photo resolution on the face recognition result.**

**Index Terms: color models, Face Recognition, Face Segmentation.**

## I. INTRODUCTION

The proposed system is designed to recognise the faces from the color group image. Face recognition system has two modules: face detection and face recognition. In a group photo the faceregions are detected. Then the detected face is recognized by comparing with the database face image. Forface segmentation, HSV and YCbCr components will be identified from the given RGB components. From this the skin elements will be identified. Then using image segmentation, the skin and non-skin areas will be separated into two segments. Then the skin elements will be marked. After face detection, the faces should be recognized. The GLCM features of the face image are extracted. The same process will be applied onthe database face images. The features of the detected face will be compared with the features of the existing database faces and recognized. Proposed system extracts and recognize individuals from the group photograph containing multiple people. Also with this the algorithm is tested by taking various resolution of the same input photo for the face detection and face recognition. Also with this the individual photos which are stored in the database also resized to determine the proper size of the photos so face recognition will be correct.

## II. LITERATURE REVIEW

Yang et.al [1] classified face detection methods in four categories. (i) Knowledge based (ii) feature invariant (iii) template matching (iv) appearance based. H C Vijay Lakshmi et.al, proposed a Segmentation Algorithm for Multiple Face Detection in Color Images with Skin Tone Regions using Color Spaces and Edge Detection Techniques, in which different color space models, specifically, HSI and YCbCr along with Canny and Prewitt edge detection techniques are used for better face detection [2].Diedrick Marius et.al, worked on Face Detection Using Color Thresholding, and Eigen-image Template Matching, compared and used the YCbCr, HSV color model for face detection and segment an image based on Skin color [3].Arti Khaparde et.al, proposed an algorithm based on color segmentation and morphological operation like closing, opening andconnecting etc and applied segmentation on HIS and YCbCr color model [4].Michael Padilla et.al, presented automatic Face Detection Using Color Based Segmentation and Template/Energy Thresholding and they compared the RGB, HSV and YCbCr Color model techniques for face detection and also applied some morphological operation for better accuracy [5]. Rabia Jafri et.al, discussed different survey of face recognition techniques that operate on intensity images, deal with video sequences, and those which require other sensory data such as 3D information or infra-red imagery [6]. Haralick et. Al suggested the use of Gray-tone Spatial-dependence matrices also called Gray-level co-occurrence matrices (GLCM) to extract texture features from an image. Since then, GLCMs became widely used for image texture features extraction in many types of applications [7]. The benchmark data set called Brodatz database is considered [8].

## III. SYSTEM OVERVIEW

The input of a face recognition system is always an image or video stream. The output is an identification or verification of the subject or subjects that appear in the image or video. Some approaches define a face recognition system as a three step process - see fig 1. From this point of view, the Face Detection and Feature Extraction phases could run simultaneously.

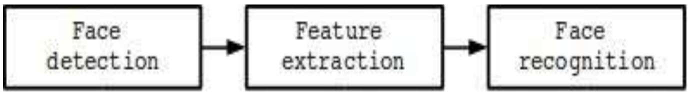


**Fig. 1: A generic face recognition system**

Face detection is defined as the process of extracting faces from scenes. So, the system positively identifies a certain image region as a face. The next step -feature extraction- involves obtaining relevant facial features from the data. These features could be certain face regions, variations, angles or measures, which can be human relevant (e.g. eyes spacing) or not. Finally, the system does recognize the face. In an identification task, the system would report an identity from a database. This phase involves a comparison method, a classification algorithm and an accuracy measure.

## IV. PROPOSED ALGORITHM FOR FACE DETECTION AND RESULTS

The complete flow chart of face detection is shown in fig2.Segmentation is subdividing an image into its constituent regions or object. The level up to which the subdivision is carried out depends on the problem being solved. In the literature, there are many color based face detection algorithm, but the proposed algorithm uses the two color spaces only namely, HSI and YCbCr. The bounding ranges calculated for the values of H, Y, Cb and Cr were used to generate the binary images. The image is converted into HSV and YCbCr color model. By various training set the range of chrominance and hue values are defined as

$$0.05 < H < 0.07 \quad (1)$$
$$100 < Cb < 110\ 9 \quad (2)$$
$$140 < Cr < 150 \quad (3)$$

The pixels that satisfied these three conditions are considered as skin elements. Others are considered as non skin elements. Then the image is segmented into two segments called skin elements and non skin elements. To eliminate small elements and holes like eye, spectacles morphological operations such as erosion and binary open are used. Now we have the other organs like hand in the skin segment. To eliminate these we are using template matching.

Fig 3 and 5 shows the original images & fig 4 and 6 shows the image after the algorithm is applied on them. To evaluate the performance of the proposed algorithm, following parameters are taken in to consideration.The parameters under consideration are number of faces, detected faces, number of repeat faces, false positive, and time to execute the algorithm and accuracy of face detection


**Fig. 2: Algorithm of Face Detection**

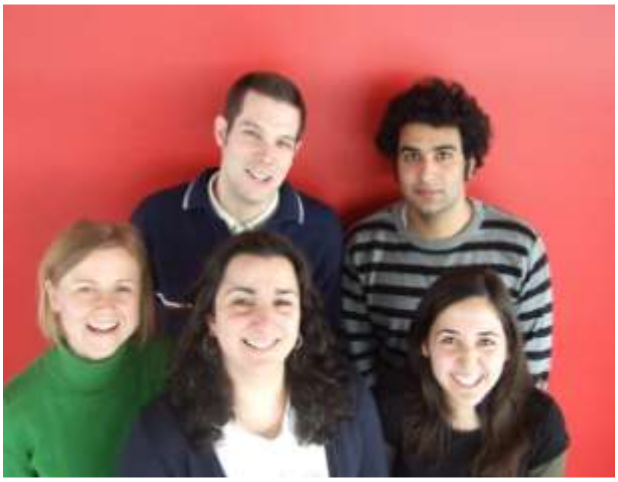

**Fig. 3. Input Image 1**

**Fig. 4 Detected faces of image1**

**Fig. 5 Input Image 2**

**Fig. 6 Detected faces of image2**

Table I shows the performance evaluation of the proposed algorithm and the overall accuracy of the algorithm is found out to be 68%.

**Table I: Performance evaluation of proposed algorithm**

| | | |
|---|---|---|
| Figure 4 (a) | Number of faces | 04 |
| | Detected faces | 04 |
| | False positive (Wrong detections) | 02 |
| | Time to execute | 1.560 sec |
| | Accuracy | 72% |
| Figure 6 (a) | Number of faces | 06 |
| | Detected faces | 06 |
| | False positive (Wrong detections) | 00 |
| | Time to execute | 1.768 sec |
| | Accuracy | 85% |

## V. PROPOSED ALGORITHM FOR FACE RECOGNITION AND RESULTS

We developed an algorithm in order to develop a face recognition system based on the GLCM. After the detection of faces from the images next step is cropping of each detected face. Each cropped image is assigned to a separate thread for the recognition purposes. This can be achieved by cropping the first detected face from the image and compare it with the database. This is called the selection of region of interest. In this way faces are verified one by one with the face database using the GLCM method. Fig.7 shows the cropped faces from image.

**Fig 7: Database of Cropped Faces**

The complete flow chart of proposed face recognition is shown in fig 8. Using GLCM extracts the features of detected faces. The obtained detected face features are compared with the features of database images which are extracted using GLCM technique for face recognition. Texture features or more precisely, Gray Level Co-occurrence Matrix (GLCM) features are used to recognize the faces from color group photo. Five co-occurrence matrices are constructed in four spatial orientations horizontal, right diagonal, vertical and left diagonal (0°, 45°, 90° , and 135°). A fifth matrix is constructed as the mean of the preceding four matrices. Texture Features (Gray Level Co-occurrence Matrix Features). From each co-occurrence matrix, a set of five-feautres are extracted. Let P be the N*N co-occurrence matrix calculated for each sub-image, then the features are as follows:

**Table II: Texture Features**

| Property | Formula |
|---|---|
| 'Contrast' | $\sum_{i,j} \|i-j\|^2 p(i,j)$ |
| 'Correlation' | $\sum_{i,j} \frac{(i-\mu i)(j-\mu j)p(i,j)}{\sigma_i \sigma_j}$ |
| 'Energy' | $\sum_{i,j} p(i,j)^2$ |
| 'Homogeneity' | $\sum_{i,j} \frac{p(i,j)}{1+\|i-j\|}$ |

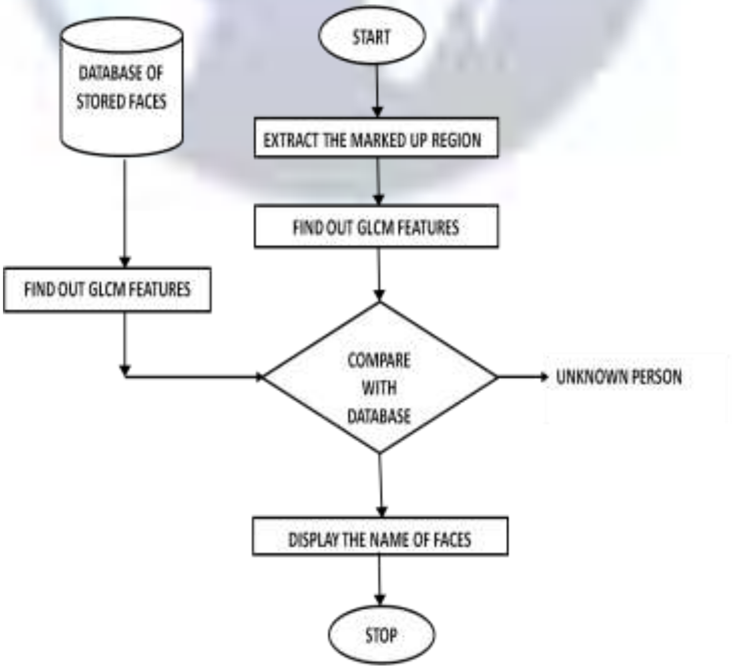


**Fig 8: Proposed algorithm for face recognition**

Fig 9 and 11 shows the face detected images & fig 10 and 12 shows the recognized image after the algorithm is applied on them.

**Fig.9: Detected faces of image1**

**Fig.10: Recognized faces of image1**

**Fig.11: Detected faces of image2**


**Fig. 12: Recognized faces of image2**

## VI. RESULT ANALYSIS

The analysis has done by minimizing the size of photograph of input image. After minimizing the size of input photograph which is of the size 640x480 initially by 10% we observed that faces will be detected till the photograph size is resized up to 90x68 but faces will be recognized if the photograph size is resized till 600x450. Beyond that if photograph size is reduced the faces will not be recognised .It means that face recognition is possible till we resize the original image up to 10%. From this we can conclude if we reduce the size of the photograph faces will be detected correctly but recognition will not be proper. So for correct face recognition we can reduce the size of the input photo till 10% of the original size. On other hand if we reduce the size of the individual faces which are stored in the database which are used comparison for the recognition. it is observed that we can reduce the size of these faces up to 10% of the original image. So beyond that we cannot reduce the size of the database photos otherwise it will not give proper result.

## VII. CONCLUSION

The aim of the proposed project was to develop an efficient human face recognition system in image that would provide a high probability of appropriate face recognition. The human face recognition system developed has been successful in achieving its set objectives. Also the project can work efficiently for reduction of input image as well as database image resolution up to 10%. By the realization of the proposed system we have learnt many aspects of human face recognition system. The project can be revised further in terms of additional functionalities and features that can be appended to the developed system in the future.

## VIII. FUTURE SCOPE

With the Image-based face recognition is still a very challenging topic after decades of exploration. Face recognition systems used today work very well under constrained conditions, although all systems work much better with frontal images and constant lighting. All current face recognition algorithms fail under the vastly varying conditions. Sensitivity to variations in pose is still a challenging problem.

Also face recognition using colored images is a topic to be explored. The scope for future development of our project is enormous. The field of face recognition incorporating colored images is still new field with huge scope of exploration. Face recognition gives best result when image is frontal and effect of illumination is very less.

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