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# A Method for Face Segmentation, Facial Feature Extraction and Tracking

Prof. Samir K. Bandyopadhyay
*Department of Computer Science & Engineering, University of Calcutta, 92 A.P.C. Road, Kolkata – 700009, India*

***Abstract*** **-An important topic in face recognition as well as in video coding or multi-modal human machine interfaces is the automatic localization of faces or head and- shoulder regions in visual scenes. The algorithms therefore should be computationally efficient and robust against distortions like varying lighting conditions. This paper describes a method for segmenting frontal head and shoulder views of persons from grey level images. The segmentation is done by oriented template correlation. This matching method only depends on edge information, especially the orientation of the edges. In the matching stage we calculate the possibility for a face at the current image position using this model. The detection capabilities of the presented algorithm are evaluated on a large database of 1004 images each containing one or more faces.**

***Keywords:*** **Face segmentation, Face position detection, Facial feature extraction and Segmentation**

## 1. INTRODUCTION

Human face detection has drawn considerable attention in the past decades as it is one of the fundamental problems in computer vision. Given a single image, the ideal face detection should identify and locate all faces regardless of its three-dimensional position, orientation, and lighting conditions. The existing face detection techniques can be classified into four categories, namely, knowledge-based methods, feature invariant approaches, template matching methods, appearance based methods.

Human face detection and segmentation is an active research area until recently. This field of research plays an important role in many applications such as face identification system, face tracking, video surveillance and security control system, and human computer interface.

Those applications often require segmented human face which is ready to be processed. There are many factors that influence the success of human face detection and segmentation. Those factors include complex colour background, condition of illumination, change of position and expression, rotation of head, and distance between camera and subject.

Face detection is a sub branch of object detection. The human face is a dynamic object and has a high degree of variability in its appearance, which makes face detection a difficult problem in computer vision.

Images containing faces are essential to intelligent vision-based human computer interaction, and research efforts in face processing include face recognition, face tracking, pose estimation, and expression recognition. However, many reported methods assume that the faces in an image or an image sequence have been identified and localized. To build fully automated systems that analyse the information contained in face images, robust and efficient face detection algorithms are required.

Given a single image, the goal of face detection is to identify all image regions which contain a face regardless of its three-dimensional position, orientation, and lighting conditions. Such a problem is challenging because faces are non- rigid and have a high degree of variability in size, shape, colour, and texture. Numerous techniques have been developed to detect faces in a single image.

Face detection and localization is the task of checking whether the given input image contains any human face, and if so, returning the location of the human face in the image. The wide variety of applications and the difficulty of face detection have made it an interesting problem for the researchers in recent years.

Face detection is difficult mainly due to a large component of non-rigidity and textural differences among faces. The great challenge for the face detection problem is the large number of factors that govern the problem space. The long list of these factors include the pose, orientation, facial expressions, facial sizes found in the image, luminance conditions, occlusion, structural components, gender, ethnicity of the subject, the scene and complexity of image's background.

The scene in which the face is placed ranges from a simple uniform background to highly complex backgrounds. In the latter case it is obviously more difficult to detect a face. Faces appear totally different under different lighting conditions. Not only do different persons have different sized faces, faces closer to the camera appear larger than faces that are far away from the camera.

## 2. EARLIER WORKS

Human face detection has drawn considerable attention in the past decades as it is one of the fundamental problems in computer vision. Given a single image, the ideal face detection should identify and locate all faces regardless of its three-dimensional position, orientation, and lighting conditions. The existing face detection techniques can be classified into four categories, namely, knowledge-based methods, feature invariant approaches, template matching methods, appearance based methods.

The use of colour information has been introduced to the face-locating problem in recent years. Most publications [1-5] have shown that colour is a powerful descriptor that has practical use in the extraction of the face detection.

Modelling skin colour requires choosing an appropriate colour space and identifying a cluster associated with skin colour in this space. YIQ colour space is used in commercial colour television broadcasting. YCbCr space is a hardware orientated model and is used in most video standards [11]. So an effective use of the chrominance information for modelling human skin colour can be achieved in these colour space. Second, this format is typically used in video coding, and therefore the use of the same format for segmentation will avoid the extra computation required in conversation.

Many research studies [6- 8] assume that chrominance components of skin-tone colour are independent of the luminance component. In fact, the skin-tone colour is non-linearly dependent on luminance. Researcher found that although skin colours of different people appear to vary over a wide range, they differ less in chrominance than brightness, specially the skin colours from a compact area in the YCbCr plane [9-10].

## 3. PROPOSED METHOD

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. Edges characterize boundaries and are therefore a problem of fundamental importance in image processing and an important tool for image segmentation . The concept of edge is highly useful in dealing with regions and boundaries as an edge point is transition in gray level associated with a point with respect to its background. Edges typically occur on the boundary between two regions.

Segmentation is a process that partitions an image into regions. In the problem of face detection, skin segmentation helps in identifying the probable regions containing the faces as all skin segmented regions are not face regions and aids in reducing the search space. Though there are different segmentation methods, segmentation based on colour is considered. Precise segmentation of the input image is the most important step that contributes to the efficient detection and localization of multiple faces in skin tone colour images.

This paper is based on the image segmentation method, the inputs are images and, outputs are the attributes extracted from those images. Segmentation divides image into its constituent regions or objects. Segmentation plays an important role in image analysis. The goal of segmentation is to isolate the regions of interest (ROI) depending on the problem and its characters. The approach is to partition an image based on abrupt changes in intensity, such as edges in an image and partitioning image into regions that are similar according to a set of predefined criteria.

In this paper we propose a new segmentation scheme for Segmentation of facial image. We start by identifying the left baseline of the facial image from the face template. We then draw a line vertically from top to bottom identifying the left boundary of the face. We then scan the face boundary on the right side to locate the rightmost pixel on the face contour.

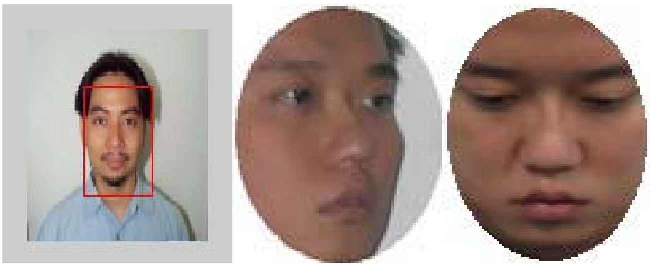
After the pixel is located we draw another vertical line from top to bottom passing through the rightmost pixel thus partitioning the image only to the region of Interest of face. This process optimizes the algorithm and increases the processing efficiency. At this stage we try to locate all paths that are circular or terminate either on the left base line or the bottom of the image, forming a closed structure. This process removes all noise and discrete objects from the edge map that are inconsequential to the image.

We start by locating all the paths that originates from the top margin line namely the first row of the image. The algorithm travels each individual path and stores them on the plotting list. This list is plotted on another image if the path is circular or end on the last row of the image or the vertical line representing the left boundary of the face. After all pixel paths on the first row are traversed the algorithm repeats similar scanning and traversal of all pixel paths from the row that is indicated by dividing the image vertically into sixteen segments, like a ladder. The first row of each segment of the ladder is used for locating pixel paths for traversal. All complete paths are then plotted on another image thus providing the anatomical regions of the facial image.

**Algorithm**

Step 1. Scan the image from the Left side of the image to locate the leftmost pixel of the face region.
Step 2. Draw a vertical line along this pixel from top to bottom representing the Left baseline or boundary.
Step 3. Scan the image from the right side of the image to locate the rightmost pixel of the facial region.
Step 4. Draw a vertical line along this pixel from top to bottom.
Step 5. Partition the obtained rectangle horizontally into sixteen segments and start with the first row of the first segment.
Step 6. Scan the enclosed rectangle from the right side to left, from the first row of the segment.
Step 7. Obtain a pixel that is black indicating an edge path, traverse the pixel path by considering all the surrounding pixels in a clockwise priority and consider the pixel with the highest priority.
Step 8. The pixels that surrounded the edge pixel, but are of lower priority are stored in a Backtrack Stack to be used only if the traversal process reaches a dead end.
Step 9. If a dead end is reached, pop out from the Backtrack stack a lesser priority pixel and continue with the traversal process.
Step 10. Store the pixels traversed in a Plotting List for plotting.
Step 11. Traversal continues to the next pixel till it reaches the left baseline or the bottom of the image or the start position is reached.
Step 12. If the traversal is terminated, the plotting list is erased and continues from Step7.Else plot pixels from the Plotting List.
Step 13. Continue to Step6 till all black pixels, indicating an edge path, is traversed.
Step 14. Move to the first row of the next segment and continue from Step6 to Step11.
Step 15. Exit

The results obtained are shown in figure 1.



**(a) (b) (c)**

**Figure 1 (a) Template of the Face**
**(b) Segmentation of Side Face**
**(c) Segmentation of Front Face**

## 4. CONCLUSIONS

In this paper, a segmentation algorithm for face detection in face images with skin tone regions is proposed. It is demonstrated that edge detection when used along with the skin segmentation based on skin chromaticity values from combination of multiple spaces gives a better segmentation result.

## 5. REFERENCES


[1] R. Feraud, O.J. Bernier, E. Viallet and M.Collobert, "A Fast and Accurate Face Detection Based on Neural Network", *IEEE Trans. Pattern Analysis and Machine Intelligence* vol. 23, no. 1, 2001, pp.42-53.

[2] R. K. Singh and A. N. Rajagopalan, "Background learning for robust face recognition", *Int'l Conference on Pattern Recognition*, 2002.

[3] J. Yang and A.Waibel, "A Real-time Face Tracker", *Proceedings of WACV'96*, 1996, pp. 142–147.

[4] H.A. Rowley, S. Baluja and T.Kanade, "Neural Network-Based Face Detection", *IEEE Trans. PatternAnalysis and Machine Intelligence*, vol. 20, no. 1, Jan 1998, pp. 23-38.

[5] H.A. Rowley, S. Baluja and T.Kanade, "Rotation Invariant Neural Network-Based Face Detection", *Proc IEEE Conf. Computer Vision and Pattern Recognition*, 1998, pp 38-44.

[6] C.H. Lee, J.S. Kim, K.H. Park, "Automatic Human Face Location in a Complex Background Using Motion and Color Information", *Pattern Recognition*, vol. 29, no. 11, 1996, pp. 129-140.

[7] K. Sobottka, I. Pitas, "A Novel Method for Automatic Face Segmentation, Facial Feature Extraction and Tracking", *Signal Process. Image Communication*, vol. 12, no. 3, 1998, 263-281.

[8] Hsu, Rein-Lien, Abdel-Mottaleb, Mohamed, Jain, and Anil K. "Face Detection in Color Images". *IEEE Trans. Pattern Analysis and Machine Intelligence,* vol. 24, no. 5, 2002, pp. 696-706.

[9] A. Pentland and M. Turk. Eigenfaces for recognition. *Journal of Cognitive Neuroscience*, 3(1):71-86, 1991.

[10] H. A. Rowley. *Neural Network-Based Face Detection.*PhD thesis, Carnegie Mellon University, Pitsburgh, 1999.

[11] K. Sobottka and I. Pitas. Looking for faces and facial features in colour images. *Pattern Recognition and Image Analysis: Advances in Mathematical Theory and Applications, Russian Academy of Sciences,* 7( 1):23-38, 1997. *GENCE,* 10(6):849-865, 1988.