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Face Detection Using Matlab Based On Morphological Processing Algorithm (Toolbox Used:- Image Processing)

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Abstract:

Face detection has been a fascinating problem for image processing researchers during the last decade because of many important applications such as video face recognition at airports and security check-points, digital image archiving, etc. In this paper, we attempt to detect faces in a digital image using various techniques such as skin color segmentation, morphological processing, template matching, Fisher linear discriminant (FLD), eigenface decomposition, and support vector machines (SVM). We determined that the more complex classifiers did not work as well as expected due to the lack of large databases for training. Reasonable results were obtained with color segmentation, template matching at multiple scales, and clustering of correlation peaks.

Key words: *Face Detection, YCbCr Model, Skin Segmentation, Algorithm Design*

1.Introduction

Automatic face detection is a complex problem in image processing. Many methods exist to solve this problem such as template matching, Fisher Linear Discriminant, Neural Networks, SVM, and MRC. Success has been achieved with each method to varying degrees and complexities.

The assignment given to us was to develop an algorithm capable of locating each face in a color image of the class. We were given seven training images along with the corresponding ground truth data to develop and train our algorithms on. The end result for our group was an algorithm capable of finding over 95% of the faces in all but one image in approximately 30 seconds. In addition, we are able to successfully locate one of the females in two test images.

The goal of this paper is to detect and locate human faces in a color image. A set of seven training images were provided for this purpose. The objective was to design and implement a face detector in MATLAB that will detect human faces in an image similar to the training images has been studied extensively. A wide spectrum of techniques have been used including color analysis, template matching, neural networks, support vector machines (SVM), maximal rejection classification and model based detection. However, it is difficult to design algorithms that work for all illuminations, face colors, sizes and geometries, and image backgrounds. As a result, face detection remains as much an art as science.

Our method uses rejection based classification. The face detector consists of a set of weak classifiers that sequentially reject non-face regions. First, the non-skin color regions are rejected using color segmentation. A set of morphological operations are then applied to filter the clutter resulting from the previous step. The remaining connected regions are then classified based on their geometry and the number of holes. Finally, template matching is used to detect zero or more faces in each connected region. A block diagram of the algorithm is shown in Figure 3.

Figure 1: Original Face

The final paper consisted of the challenge of correctly locating the faces of the students in the class in several outdoor photographs, with extra credit being awarded for identifying females. The images were provided at quite high resolution and were taken with reasonably consistent lighting but the relative sizes of the faces varied with the degree of zoom of the camera. Most of the images further exhibited significant overlap of faces with little or no border between them.

2.Proposed Algorithm

The face detection in color images based on intensity function is specified as follows:

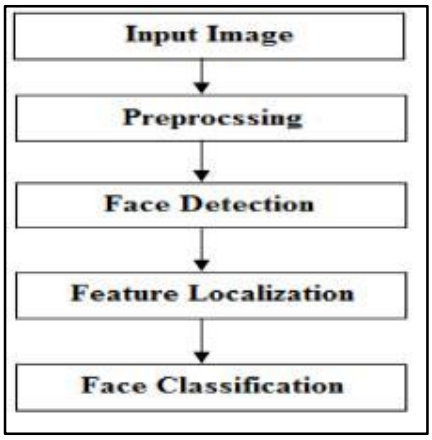

Figure 2: Flow Chart Of Proposed Algorithm

3.Algorithm Followed

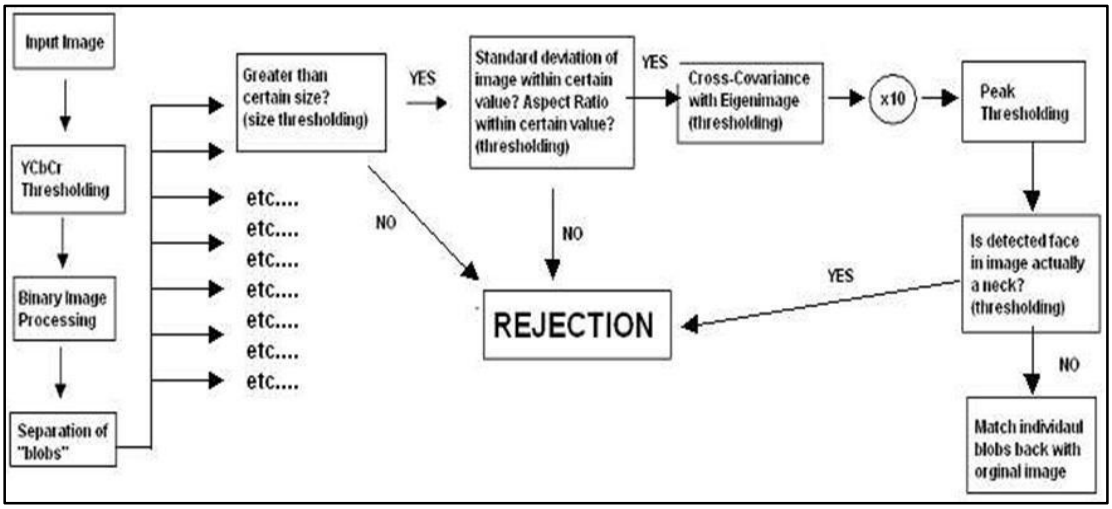

Figure 3: Block Diagram Of Algorithm

4.Face-Detection Mechanism

The basic form of this algorithm follows a process that was very common among former people. The following two steps are performed: Using these techniques, the faces in the input images were recognized quite

- Skin Detection – Since the training set and the final image are all full colour images, the is the separation of skin pixels from non-skin pixels can be accomplished quite effectively.
- Template Matching – By running only the skin pixels through a template matching algorithm, the faces can be separated from other visible skin such as arms or legs more general circumstances,for this approach

5.Skin Segmentation

The first step in the face detection algorithm is using skin segmentation to reject as much "non- image based on skin color: converting the RGB picture to YCbCr space or to HSV space. A YCbCr space segments the image into a luminosity component and color components, whereas an HSV space divides the image into the three components of hue, saturation and color value.

The main advantage of converting the image to the YCbCr domain is that influence of luminosity can be removed during our image processing. In the RGB domain, each component of the picture (red, green and blue) has a different brightness. However, in the YCbCr domain all information about the brightness is given by the Y-component, since the Cb (blue) and Cr (red) components are independent from the luminosity. The following conversions are used to segment the RGB image into Y, Cb,Cr components

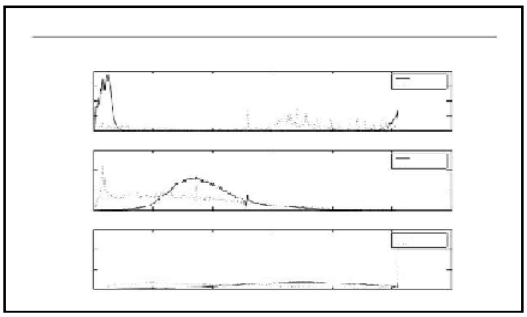

Figure 4: A Histogram Representation

As the histograms show, there is a fairly distinct separation between skin and non-skin in the hue and saturation coordinates with less separation in the value coordinate. Using only the first two the face" of the image as possible, since the main part of the images consists of non-skin color pixels. There are two ways of segmenting

$$0.257 * R + 0.504 * G + 0.098 * B + 16$$
$$0.148 * R + 0.291 * G + 0.439 * B + 128$$

indication on whether a pixel is part of the skin or not. This can clearly be seen in Figure (above) which are the Cb and Cr values of all the pixels that are part of the faces in the first fiveimage-differentiated using the "ground truth data" on the project website. There is a strong correlation between the Cb and Cr values of skin pixels, as shown in figure 2. Figure 3 shows the Cb and Cr components of the entire training image, to reveal the comparison between faces and nonfaces in the YCbCr space. From these figures, it is apparent that background and faces can be distinguished by applying maximum and minimum threshold values for both Cb and Cr components. Note However, that even with proper thresholds, images containing other parts of the body, such as exposed arms, legs, and other skin, will be captured, and must be removed in image processing steps.

coordinates, a joint PDF was created that could be While the resulting skin mask was certainly a nice approximation, there were still some annoying artifacts. For example, the undersides of the beams in the background were still visible as were some pixels in the clothing of the people in the image. In an attempt to improve on this approximation, the third remaining coordinate, value, was added to create a three-dimensional joint PDF of the entire color space. The final implementation of the skin detector used this PDF to perform the skin vs. non-skin approximation.

The resulting skin mask appears to contain only skin pixels, but it also appears to have some holes. To resolve this problem, some binary morphological processes were performed. The image was first dilated in order to try to connect the pixels in each individual face. A "filling" step was then performed to fill in any holes such as in the eyes and under the chin. Finally, the image was eroded to remove the extra pixels that were selected around the edges of the faces during the dilation step. Figure 5 below shows an example of the final step of this procedure.

Figure 6: Examples of Result of Skin Detection Step

6.Result

The proposed model was implemented using 7 images. The performance of our proposed method is better than that of existing color image enhancement algorithms. Experiments show that the proposed algorithm for face detection has a very good performance in detecting low quality faces and faces affected by environmental lightning conditions. However, it is sensitive to pose rotated faces and faces corrupted by other objects.

The detection rates and false positive rates on test sets are listed in Table 1. Note that the false detection especially is very low, while the detection rate is acceptable. Examples from the face database are shown in Figure 5.

The proposed model was implemented using five images. The implementation results were compared with other results and the performance of our proposed method is

better than that of existing colur image enhancement algorithms.

S.No.	Parameters	Results
1.	Total Images	7
2.	Total Faces	77
3.	Detected Faces	75
4.	False Arms & Necks	15
5.	Missed Faces	2
6.	Recall Rate	97.40%
7.	Precision Rate	94.80%

Table 1: Experimental Results

Figure 6: The Face Has Been Detected

7.Conclusion

As the initial step of the algorithm, color-space separation was by far the most effective means of eliminating non-face regions from consideration. For the subsequent face-segmentation step, we found that the very simple method of looking for face-like shapes within the skin-probability image to be effective and computationally efficient. We did not have much success with morphological processing nor detection based on actual face features such as they eyes and

mouth. These more sophisticated approaches certainly have merit in a more general-purpose face detection program. However, with our very consistent and predictable set of training images, the simplest approach proves to be more than adequate, as is evidenced by the overall accuracy rating of 98%, and quick execution time of roughly one minute.

Figure 7: All faces have been detected

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