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An Approach for Canny Edge Detection Algorithm on Face Recognition

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Abstract: ***The paper obtainable here is a challenge to use a canny edge detection algorithm for face recognition. Defined an edge as a set of related pixels that forms a margin between two disjoints regions, the automatic recognition of human faces grants an important challenge to the research community of pattern recognition. There are differences in the lighting, angles , facial expressions and poses, further set a problem to the face recognition research. This paper proposes a new approach, canny edge detection method for face recognition and image color space transformation, Gaussian Filter Coefficient and Hysteresis thresholding using two values for thresholding, High and Low. The proposed method works efficiently with images and performs better than all other edge detection algorithm.***

Keyword: Canny edge detection algorithm, Gaussian Filter, Hysteresis thresholding

1. Introduction

Facial recognition is a visual pattern recognition task. The three-dimensional human face, which is subject to varying illumination, pose, expression etc. has to be recognized. This recognition can be performed on a variety of input data sources. The aim of face detection is localization of the face in a image. In the case of video input, it can be an advantage to track the face in between multiple frames, to reduce computational time and preserve the identity of a face (person) between frames. The face preprocessing step is to normalize the coarse face detection, so that a robust feature extraction can be achieved. Depending of the application, face preprocessing includes: Alignment (translation, rotation, scaling) and light normalization/correlation. The dimensionality of these sources can be increased by one by the inclusion of a time dimension. A still image with a time dimension is a video sequence. The advantage is that the identification of a person can be determined more precisely from a video sequence than from a picture since the identity of a person cannot change from two frames taken in sequence from a video sequence. Facial recognition systems usually consist of four steps, as face detection (localization), face preprocessing face alignment/normalization, light correction and etc.), feature extraction and feature matching.

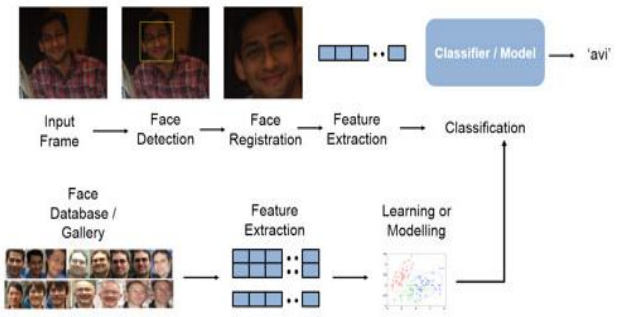

Figure 1: Facial recognition process

2. Literature Survey

Zhi-fang et al. [16] Although face recognition systems are known for decades, there are many active research work on the topic. The subject can be divided into three parts;
1. Detection
2. Recognition
The first step is face detection for face recognition system. The detection output can be location of face region as a whole, and location of face region through facial types (i.e. eyebrow, nose, eyes, mouth etc.). Detection methods in the works are difficult to classify strictly, because most of the algorithms are combination of methods for detecting faces to increase the accuracy. Kherchaoui and Houacine modeled skin color using Gaussian Distribution Model with Cb and Cr channel in YCbCr color space. Then skin like region is chosen as a face candidate with respect to the bounding box ratio of the region and candidates are verified with template matching. Another method preprocesses the given image to remove background part as a first step. It is done by applying edge detection on the Y component of YCbCr color space. Then, the closedregion is filled to take it as foreground part. After that, skin segmentation is done on YCrCb color space with conditions. The segmented parts are taken as candidate and verification is done by calculating the entropy of the candidate image and use thresholding to verify face. Face recognition techniques are described in previous paragraphs. Selection of thebest algorithm cannot be done because of nonstandard face libraries and non-universal face databases. Also, detection and recognition method can be affected by illumination changes, pose changes, occlusion, and facial expression. All methods cannot handle all effects in the same algorithm. So, it is difficult to design an algorithm that handles all effects.

3. Canny Edge Detection Algorithm

Canny's edge detector is one of the most popular edge detection algorithms. Canny proposed a list of criteria to improve edge detection method .

Algorithm Steps:

The first criterion is low error rate. That is genuine edges should not be missed and spurious edges not picked.

The second criterion is good localization. In other words, the pixels edges are found between distance by the detector and the actual edge should be minimal.

A third criterion is single edge point have only one response. This was cited since the first two are not considerable enough to totally eliminate multiple responses to an edgefor possibility. Established on these criteria, the canny's edge detector was designed.

The first step in the process is smoothing the image using a Gaussian filter. Then the image Gradient is computed using multiple first derivative operators in different directions, to highlight regions with high spatial derivatives. Then the algorithm tracks along these regions not at the maximum with the pixel that is non-maximum suppression. The array gradient is then further refined by Hysteresis. Track along the remaining pixels using hysteresis is not been suppressed. That is, first two thresholds (lower T1 and upper T2) are identified. Then points whose magnitudes are below the lower threshold are set to zero (i.e. made a non edge). Points whose magnitudes are above the upper threshold is made an edge. Those points whose magnitude is between the 2 thresholds, is fixed to zero except there is a track from this point to a point with a gradient above T2. The performance of the Canny's algorithm depends on number of parameters such as σ, standard deviation for the Gaussian filter and lower and upper threshold values T1 and T2. The value of σ controls the size of the Gaussian filter. Larger the scale of the Gaussian filter, lesser the accuracy of localization of the edges. Whereas smaller values of σ imply a smaller Gaussian filter which limits the amount of blurring, maintaining finer edges in the image. As can be seen, Canny's algorithm performs better than all the other gradient based methods and LoG filters in detecting all the fine edges and localizing them correctly. However the drawback of the Canny's algorithm is it generates lots of spurious edges corresponding to weak edge points in the image.

4. Experimental Results

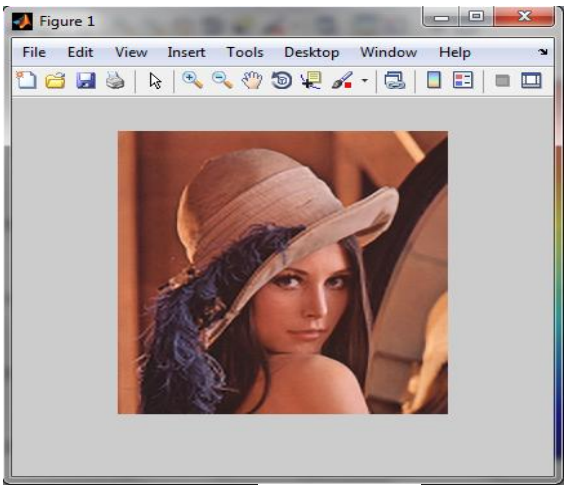

Figure 1: Gaussian Filter

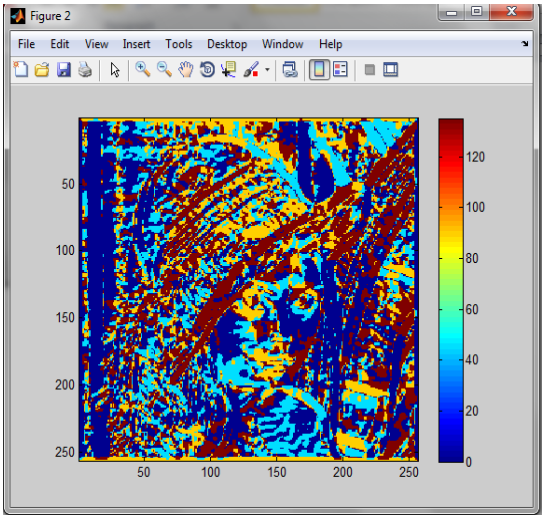

Figure 2: Filter for horizontal and vertical orientation

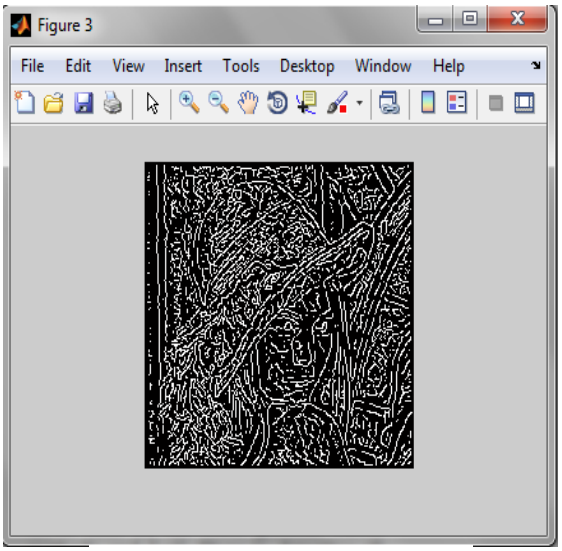

Figure 3: Hysteresis Threshold low

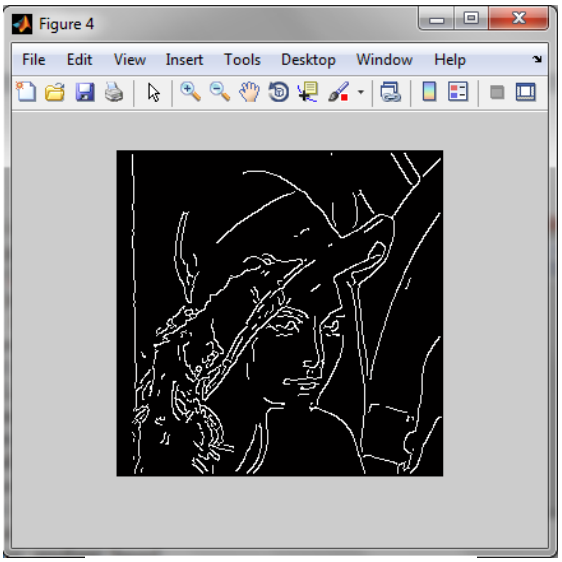

Figure 4: Hysteresis Threshold high

Table 1: Parameter Setting and time

Algorithm	Image 1	Image 2
Canny Algorithm	σ =2	σ =2
Parameters	Adaptive Threshold	Adaptive Threshold
Time	41ms	51ms

We select an image file and apply canny algorithm with the following steps and the result is shown in figures

1) Convolution with Gaussian Filter Coefficient
2) Canny Filter for Horizontal and Vertical orientation with convolution.
3) Directions calculated using a tan
4) Adjusting to nearest 0, 45, 90, and 135degree.
5) Non-Maximum Suppression
6) Hystheresis Thresholding (high and low)

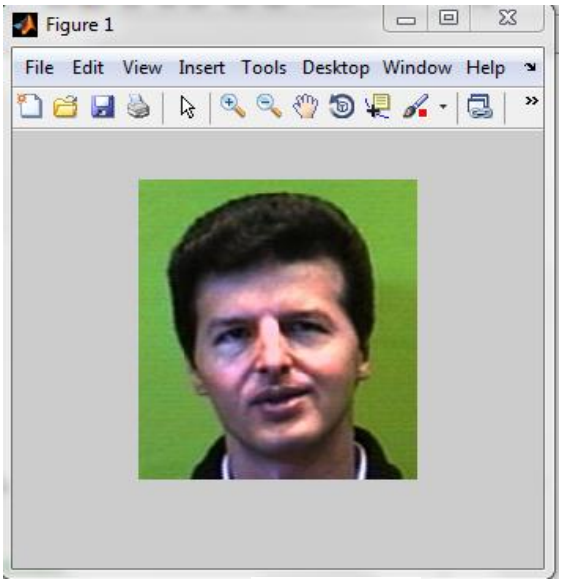

Figure 1: Gaussian Filter\

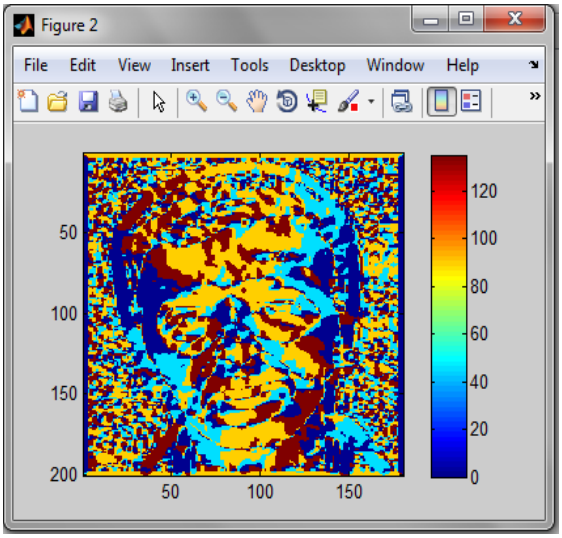

Figure 2: Filter for horizontal and vertical orientation

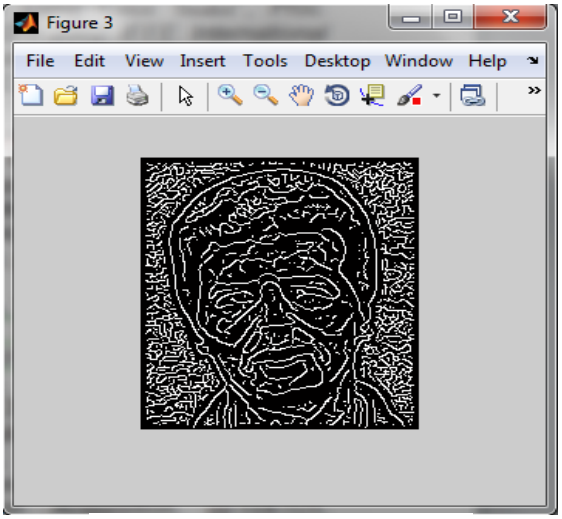

Figure 3: Hysteresis Threshold low

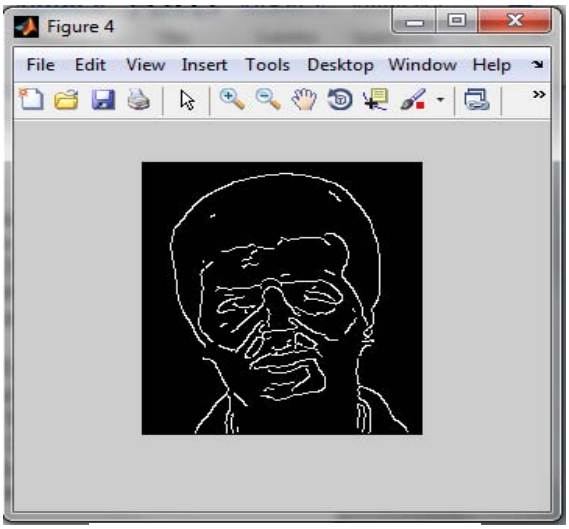

Figure 4: Hysteresis Threshold high

5. Conclusion

Canny operator can be applied to different situations. Canny operator can detect the edge clearly. In order to improve its performance, we propose the calculation of gradient magnitude and gradient direction based and make the adaptive calculation of the threshold of Canny operator method. The experimental results show that the edge detected by the improved Canny operator has more continuity, and greater to noise ratio.

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