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A Comparative Analysis on Edge Detection Techniques Used in Image Processing

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Abstract : *This paper proposes the adaptation and optimization of two edge detector algorithms used for feature set extraction in CBIR. This paper compares the performance of Sobel and Canny edge detectors and proposed better solution for feature extraction in CBIR. It has been shown that the Canny edge detection algorithm performs better than Sobel edge detection with compromise of time. This work is implemented using MATLAB 7.10.0.*

INTRODUCTION

Edge detection is a very important area in the field of Image processing. Edges definethe boundaries between regions in an image, which helps with segmentation and objectrecognition. Edges are significant local changes of intensity in an image. Edges typically occur on the boundary between two different regions in an image.

The main problem is that different edge detectors work differently. some takes more time with respect to other, while some finds more edges(works deeply) with respect to other. The detection of edges in an image depends upon illumination, blur, noise, intensity, objects.

The actual difference in working of various edge detectors can be analyzed by using these different algorithms in a same program or system.That is the goal of our project. We tested two edge detectors that use different methods for detecting edges and compared their results for a variety of images to determine which detector works better for different images. This data could then be used to create a multi-edge-detector system.

Edge Detection Techniques

Sobel :

It performs 2-D spatial gradient measurement on an image. The operator consists of a pair of 3×3 convolution mask. One mask is simply the otherrotated by 90°.

-1	0	+1
-2	0	+2
-1	0	+1

+1	+2	+1
0	0	0
-1	-2	-1

GxGy

These masks are designed to respond maximally to edges running vertically and horizontally relative to thepixel grid, one for each of the two perpendicular orientations. The masks can be applied separately to the input image, to produce separate measurements of the gradient. The magnitude of gradient is given by:

$$|G| = \sqrt{Gx^2 + Gy^2}$$

The direction of gradient is given by:

$$\theta = \arctan(Gy / Gx)$$

The edge pixel, E(m, n), is then given by:

E(m, n) = |G(m, n) *Gx| + |G(m, n) *Gy|

where G(m, n) are the pixels from the input image, G.

Canny:
This method was proposed by John F. Canny in 1986. Even though this method is quite old but is still used because of its precision in edge detection. The main advantage of this method is elimination of multiple responses to a single edge. It also having good localization property, means the detected edges are much closer to the real edges. The response of this detector is also good, as the original edge does not result in more than one detected edge. The gradient magnitude and direction is calculated by using first order finite differences.

Implementation and results:
We applied both the above mentioned algorithms to different form of images, that is to clipart images, photographs (color images), grey scale images and noisy images


Fig 1. Input Image Fig 2. Grey Image

Fig 3.Resut of Sobel

Fig 4. Result of Canny

From the above pictorial descriptions it is clear that Canny works better than the Sobel. Moreover it is clear that the Canny edge detecting algorithm is more precise because the edges that were not shown by Sobelare easily detected by Canny detector. The only disadvantage of Canny is that it takes more time as compared to Sobel.

Analysis on Noisy image:

We added salt and pepper noise to the image and when it is passed through the detectors, the results are

Fig 5.Noisy Image Fig 6. Gray Image

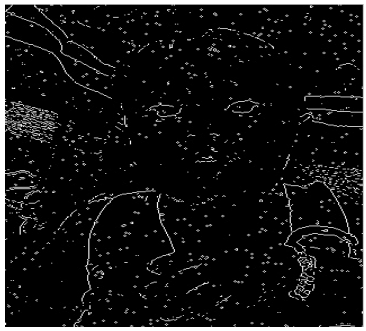

Fig 7. Result of Sobel

Fig 8. Result of Canny

Analysis on the basis of Speed:

The speed of canny is slow because of its deep processing.

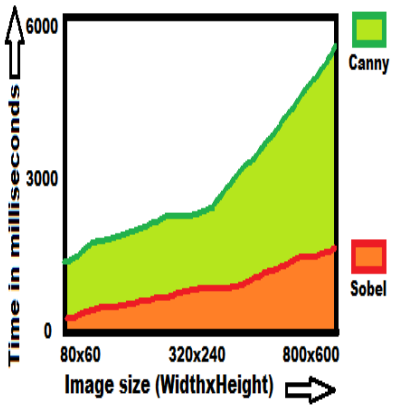

Fig 9. Speed Comparison

Conclusions:

The edge detection holds a big importance in image retrieval, image recognition and in segmentation. Sobel edge detector is fast in processing but is less precise. Canny'smethod produces single pixel thick,

continuous edges and is precise, but also is bit slower in processing as compared to Sobel. The major requirement by a user is a system that gives good result even in the presence of noise and canny proves to be better as shown by the results and fulfills the noise rejection requirement by a user.

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