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COMPARATIVE ANALYSIS OF VARIOUS EDGE DETECTION MECHANISMS

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Abstract: Edges are known as boundaries between different textures. Edge can also be defined as discontinuities in image(graphics) intensity from one pixel to another. Edges for an image(graphics)are always important characteristics that offer an indication for a higher frequency. Detection of the edges for an image(graphics)may help for image(graphics)segmentation, data compression, and also help for well matching, such as image(graphics)reconstruction and so on. There are many methods to make edge detection. most common method for edge detection is to calculate differentiation of an image. Edge detection is an image(graphics)processing technique for finding boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image(graphics)segmentation and data extraction in areas such as image(graphics)processing, computer vision, and machine vision. Common edge detection algorithms include Sobel, Canny, Prewitt, Roberts, and fuzzy logic methods.

Keywords: Edge detection, Canny Edge detection, Sobel operator

[I]Introduction

Edge detection is name for a set of mathematical methods which aim at identifying points in a digital image(graphics)at which image(graphics)brightness changes sharply or, more formally, has discontinuities. points at which image(graphics) brightness changes sharply are typically organized into a set of curved line segments termed *edges*. same problem of finding discontinuities in 1D signals is known as step detection and problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image(graphics) processing, machine vision and computer vision, particularly in areas of feature detection and feature extraction.

The edges extracted from a two-dimensional image(graphics) of a three-dimensional scene can be classified as either viewpoint dependent or viewpoint independent. A *viewpoint independent edge* typically reflects inherent properties of three-dimensional objects, such as surface markings and surface shape. A *viewpoint dependent edge* may change as viewpoint

changes, and typically reflects geometry of scene, such as objects occluding one another. A typical edge might for instance be border between a block of red color and a block of yellow. In contrast a **line** (as can be extracted by a ridge detector) can be a small number of pixels of a different color on an otherwise unchanging background. For a line, there may therefore usually be one edge on each side of line.

[II] Problem Statement

Edge detection is a basic tool used in image(graphics) processing, basically for feature detection and extraction, which aim to identify points in a digital image(graphics) where brightness of image(graphics) changes sharply and find discontinuities. purpose of edge detection is significantly reducing amount of data in an image(graphics) and preserves structural properties for further image(graphics) processing.
In a grey level image(graphics) edge is a local feature that, with in a neighborhood separates regions in each of which gray level is more or less uniform with in different values on two sides of edge**.** For a noisy image(graphics) it is difficult to detect edges as both edge and noise contains high frequency contents which results in blurred and distorted result.

[III] Different edge detection methodologies

Edge detection makes use of differential operators to detect changes in gradients of grey levels. It is divided into two main categories:

- First order
  - ❖ Canny Edge detector
  - ❖ Classical edge detectors
    - Robert operator
    - Prewitt operator
    - Sobel operator
- Second order/Laplacian based operator.

[IV]Tools and Technology

In imaging science, image(graphics) **processing** is any form of signal processing for which input is an image, such as a photograph or video frame; output of image(graphics) processing may be either an image(graphics) or a set of characteristics or parameters related to image. Most image-processing techniques involve treating image(graphics) as a two-dimensional signal and applying standard signal-processing techniques to it. image(graphics) processing usually refers to digital image(graphics) processing, but optical and analog image(graphics) processing also are possible.

MATLAB stores an intensity image(graphics) as a single matrix, with each element of matrix corresponding to one image(graphics) pixel. matrix can be of class double, in which case it contains values in range [0,1], or of class uint8, in which case data range is [0,255]. elements in intensity matrix represent various intensities, or gray levels, where intensity 0 represents black and intensity 1 (or 255) represents full intensity, or white.

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and

programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include: Math and computation.

[V] Comparison of Various Edge Detectors

As edge detection is a fundamental step in computer vision, it is necessary to point out true edges to get best results from matching process. That is why it is important to choose edge detectors. In this respect, we first present some advantages and disadvantages of Edge Detection Techniques, They are as follows:

Classical (Sobel, Prewitt)

The primary advantages of classical operator are simplicity. Roberts cross operator provides a simple approximation to gradient magnitude. second advantages of classical operator are detecting edges and their orientations. In this cross operator, detection of edges and their orientations is said to be simple due to approximation of gradient magnitude.

The disadvantages of these cross operator are sensitivity to noise, in detection of edges and their orientations. increase in noise to image(graphics) will eventually degrade magnitude of edges. major disadvantage is inaccuracy, as gradient magnitude of edges decreases. Most probably accuracy also decreases.

Zero Crossing (Laplacian)

The advantages of zero crossing operators are detecting edges and their orientations. In this cross operator detection of edges and their orientations is said to be simple due to approximation of gradient magnitude is simple. second advantage is fixed characteristics in all directions.

The disadvantage is sensitivity to noise. In detecting edges and their orientations are increased in noise to image(graphics) this will eventually degrade magnitude of edges. second disadvantage is that, operation gets diffracted by some of existing edges in noisy image.

Gaussian (Gobar Filter)

Gabor filter for edge detection is based on frequency and orientation representations. Gabor filters are similar to those of human perception system that is related to particularly appropriate for texture representation and discrimination. 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. Gabor filters are linked to Gabor wavelets. They can be designed for a number of dilations and rotations. In general, expansion is not applied for Gabor wavelets.

These needs are computation of bi-orthogonal wavelets, which is very time-consuming. To overcome this problem a filter bank consisting of Gabor filters with various scales and rotations are created. Gobar filters are convolved with signal, resulting in so it is called Gabor space, its advantages is Gabor function which is a good fit to receptive field weight functions. Gabor Filter is very useful in image(graphics) processing applications

using edge detection. In our case study we use it for identification of shark fish
image. It is well suited for a specific spatial location in distinctive between objects of an image. main important activations can be extracted from Gabor
space in order to create a sparse object representation.

Gaussian (Canny)

The Smoothing concept has been applied in this Gaussian operation, so finding of errors is effective by using probability. next advantage is improving signal with respect to noise ratio and this is established by Nonmaxima suppression method as it results in one pixel wide ridges as output. third advantage is Better detection of edges especially in noise state with help of thresholding method. major disadvantage is computation of Gradient calculation for generating angle of suppression. main disadvantage is Time consumption because of complex computation.

Marr-Hildreth

The main advantage of Marr-Hildreth is tested and established among wider area around pixels.

Thus finding correct places of edges seem to be very easy, which also outermost advantage in Marr-Hildreth Edge Detection. Laplacian of Gaussian (LoG) operator uses Laplacian filter for Marr's edge detection. disadvantage is that it reduces accuracy in finding out orientation of edges and malfunctioning at corners, curves, where gray level intensity function variations.

Conclusions

The edge detection is primary step in identifying an image(graphics) object, it is very essential to know advantages and disadvantages of each edge detection filters. In this paper we dealt with study of edge detection techniques of Gradient-based and Laplacian based. Edge Detection Techniques are compared with case study of identifying a shark fish type. software was implemented using MATLAB. Gradient-based algorithms have major drawbacks in sensitive to noise. dimension of kernel filter and its coefficients are static and it cannot be adapted to a given image. A novel edge-detection algorithm is necessary to provide an errorless solution
that is adaptable to different noise levels of these images to help in identifying valid image(graphics) contents produced by noise. performance of Canny algorithm relies mainly on changing parameters which are standard deviation for Gaussian filter, and its threshold values. size of Gaussian filter is controlled by greater value and larger size.
larger size produces more noise, which is necessary for noisy images, as well as detecting larger edges. We have
lesser accuracy of localization of edge then larger scale of Gaussian. For smaller values we need a new algorithm to adjust these parameters. user can modify algorithm by changing these parameters to suit different environments. Canny's edge detection algorithm is more costly in comparing to Sobel, Prewitt and Robert's operator. Even though, Canny's edge detection algorithm has a better performance. evaluation of images showed that under noisy conditions,

Canny, LoG, Sobel, Prewitt, Roberts's are exhibited better performance, respectively.

The various methodologies of using edge detection techniques namely Gradient and Laplacian transformation. It seems that although Laplacian does better for some features (i.e. fins), it still suffers from mismapping some of lines.

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