

Enhancing Edge Detection Mechanism using Canny Algorithm

Nitika* JCD Memorial college of Engineering(affiliated with GJU,Hisar)

Vipul Goyal** Assistant Professor

Abstract

Edges are boundaries between different textures. Edge also can be defined as discontinuities in image intensity from one pixel to another. The edges for an image are always the important characteristics that offer an indication for a higher frequency. Detection of edges for an image may help for image segmentation, data compression, and also help for well matching, such as image reconstruction and so on. There are many methods to make edge detection. The most common method for edge detection is to calculate the differentiation of an image. Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image 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, Sobal operator



1. Introduction

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



Fig 1.

Edge properties

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

geometry of the scene, such as objects occluding one another.

A typical edge might for instance be the 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 the line.

2. LITERATURE REVIEW

The rapid development of information technology has directly impacted on the techniques in image processing techniques and the implementation of survey processing systems. This main development has been shifted from mainframe system to PC platform. User now can easily perform all kind operations and processing techniques ranging from small scale to large scale statistical operations.

The research framework and methodology complies with ADDIE model [4,5].

ADDIE model is the generic process traditionally used by instructional designers and training developers. The five phases including Analysis, Design, Development, Implementation, and Evaluation represent a dynamic, flexible guideline for building effective training and performance support tools. Our work starts with conducting a survey to the new learners/students about their understanding on Biomedical Image Processing course to identify any problems or issues of how difficult to them to understand the Biomedical Image Processing course. To make meaningful to





these new learners, we are going to develop user friendly Biomedical Image Processing software package, which new learners can do some Biomedical Image Processing analysis through various methods that have been taught in Biomedical Image Processing course.

[i] A brief experience on journey through hardware developments for image processing and it's applications on Cryptography by Sangeet Saha, Chandrajit pal, Rourab paul,

The importance of embedded applications on image and video processing, communication and cryptography domain has been taking a larger space in current research era. Improvement of pictorial information for betterment of human perception like deblurring, de-noising in several fields such as satellite imaging, medical imaging etc are renewed research thrust. Specifically we would like to elaborate our experience on the significance of computer vision as one of the domains where hardware implemented algorithms perform far better than those implemented through software.

[ii] Comparative Study and Implementation of Image Processing Techniques Using MATLAB by Sukhjinder singh, R.k Bansal, Savina Bansal

Image enhancement aims at improving the quality of image for better visualization. This paper presents three methods of image enhancement: - GHE, LHE and DSIHE that improve the visual quality of images. In this paper, we implement and examine the effect of above mentioned techniques based on objective and subjective image quality parameters (like PSNR, NAE, SC, AE and MOS) to measure the quality of gray scale enhanced images. A comparative analysis is also being carried out. For handling gray-level images, Histogram Equalization (HE) methods (like GHE and LHE) tend to change the mean brightness of an image to middle level of the gray-level range limiting their appropriateness for contrast enhancement in consumer electronics. The DSIHE methods seem to overcome this disadvantage as they tend to preserve both, the brightness and contrast enhancement, though at the cost of naturalness of the input image.

[iii] A Study on Image Edge Detection Using the Gradients by Pinaki Pratim Acharjya, Ritaban Das, Dibyendu Ghoshal

A study on image edge detection using gradients is presented in this paper. In image processing and image analysis edge detection is one of the most

common operations. Edges form the outline of an object and also it is the boundary between an object and the background. Detecting accurate edges are very important for analyzing the basic properties associated with an image such as area, perimeter, and shape. The software tool that has been used is MATLAB 7.0

[iv]ALGORITHM AND TECHNIQUE ON VARIOUS EDGE DETECTION: A SURVEY by Rashmi, Mukesh Kumar, and Rohini Saxena

An edge may be defined as a set of connected pixels that forms a boundary between two disjoint regions. Edge detection is basically, a method of segmenting an image into regions of discontinuity. Edge detection plays an important role in digital image processing and practical aspects of our life. In this paper we studied various edge detection techniques as Prewitt, Robert, Sobel, Marr Hildrith and Canny operators.

On comparing them we can see that canny edge detector performs better than all other edge detectors on various aspects such as it is adaptive in nature, performs better for noisy image, gives sharp edges , low probability of detecting false edges etc.

3. Problem formulation

Edge detection is a basic tool used in image processing, basically for feature detection and extraction, which aim to identify points in a digital image where brightness of image changes sharply and find discontinuities. The purpose of edge detection is significantly reducing the amount of data in an image and preserves the structural properties for further image processing.

In a grey level image the edge is a local feature that, with in a neighborhood separates regions in each of which the gray level is more or less uniform with in different values on the two sides of the edge. For a noisy image it is difficult to detect edges as both edge and noise contains high frequency contents which results in blurred and distorted result.

Different edge detection methodologies

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



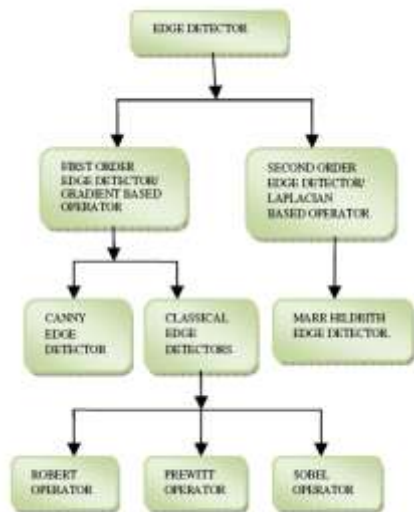


Fig2. Flowchart of Classical operators

4. Objectives

Canny edge detector have advanced algorithm derived from the previous work of Marr and Hildreth. It is an optimal edge detection technique as provide good detection, clear response and good localization. It is widely used in current image processing techniques with further improvements. Objective of research is to High light the benefit of canny edge detection over traditional edge detection schemes.

On analyzing all these edge detection techniques , it is found that canny gives optimum edge detection .Following are the some points throwing light on the advantages of canny edge detector as compared to other detectors discussed in this paper:

1. **Less Sensitive to noise:** As compared to classical operators like Prewitt, Robert and Sobel canny edge detector is less sensitive to noise. Its uses Gaussian filter which removes noise at a great extent as compared to above filters. LoG operator is also highly sensitive to noise as differentiate twice in comparison to canny operator.

2. **Remove streaking problem:** The classical operators' like Robert uses single thresholding technique but it results into streaking. Streaking means, if the edge gradient just above and adjust below the set threshold limit it removes the useful part of connected edge, and leave the disconnected final edge.

Flowchart of canny edge detection

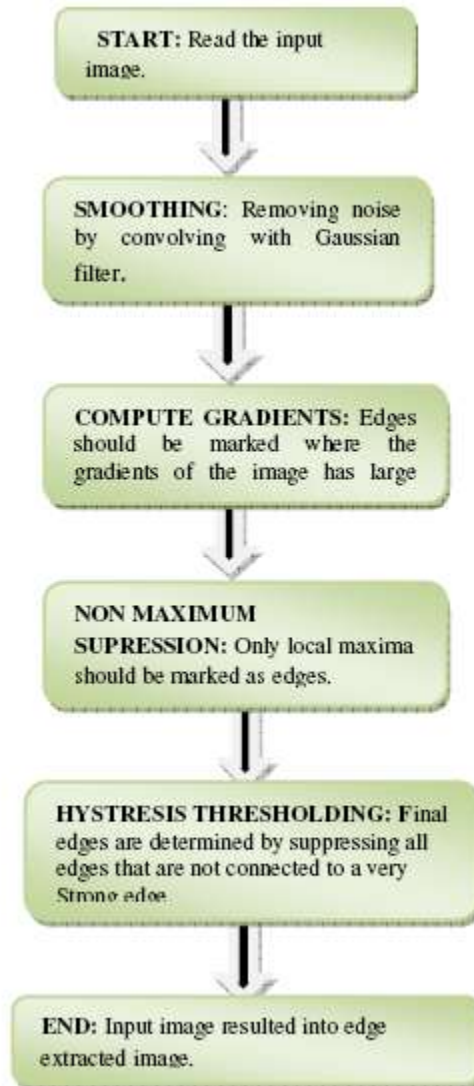


Fig 3.

To overcome from this drawback canny detector uses 'hysteresis' technique which uses two threshold values $_789$ and $_5_65$ as discussed above in canny algorithm.

3. **Adaptive in nature:** Classical operator have fixed kernels so cannot be adapted to a given image. While the performance of canny algorithm depends on variable or adjustable.

5. Methodology/ Planning of work

Our plan is to use the MATLAB programming software [6] as a tool for developing this Biomedical Image Processing software package [7,8]. Such techniques (image enhancement, filtering,





segmentation and morphological operation) in Biomedical Image Processing that have been taught in the class (or in the syllabus) will be included in the Biomedical Image Processing software package. This software package should be capable to display input image, output image and various click button for various image processing techniques as well as description of the techniques so the students will learn effectively the application on how biomedical image is analyzed instead of learning the mathematical algorithm for such techniques.

A number of software packages for the image processing and editing have increased over the years. The different steps of image processing make each of the software packages differ with different relative strengths. Having the right software and appropriate processing techniques is necessary to guarantee the reliability of the data processing.

6. Facilities required for proposed work

The famous well-developed software packages for image processing are as follow:

A. Adobe Photoshop

Adobe Photoshop is a graphics editing program and used in teaching and research. It was generally found to be useful and easy to use. It comes with functionality for scanning and scanned image manipulation. It can produce simple integration with other Adobe products.

B. Adobe Illustrator

It is the industrial standard software and works well with other graphics software. Not easily compatible with WORD and Windows PC users cannot easily send images to a non-graphics PC user.

C. ImageTool

ImageTool is a free package with powerful image processing capabilities. The main function is an image analysis and it is quite easy to use. According to the developer, ImageTool has no guaranteed future development and has no direct support.

D. LabView

Its main use is to convert from one image file format to another. A large number of image formats are supported. Images can be increased or reduced in size. Image resolution may be altered in the preparation of images for importation into word-processing or desktop publishing packages.

E. Paint Shop Pro

It is used both in teaching and research. It is regarded as easy to use and useful. It is robust, good documentation and capable in conversion between different image file formats.

F. ImageJ

ImageJ is a freeware. It is a free package with powerful image processing capabilities. The most used features of the software are image editing, processing, and enhancement.

G. Image Prep

Image Prep is a specialist graphics manipulation package which has proved to be very useful for converting and enhancing graphics images. Used for manipulation of scanned photographic images for research software generation.

HERDAS Imaging

It is a package designed to plan for surface change such as urban development, transport planning and landscape planning. It is very useful but fairly difficult to use. Very hard to start off with, but once you have conquered the initial problems it becomes a lot easier.

7. Future scope and conclusion

In this research we have studied and evaluate different edge detection techniques. We have seen that canny edge detector gives better result as compared to others with some positive points.

It is less sensitive to noise, adaptive in nature, resolved the problem of streaking, provides good localization and detects sharper edges as compared to others. It is consider as optimal edge detection technique hence lot of work and improvement on this algorithm has been done and further improvements are possible in future as an improved canny algorithm can detect edges in color image without converting in gray image, improved canny algorithm for automatic extraction of moving object in the image guidance.

It finds practical application in Runway Detection and Tracking for Unmanned Aerial Vehicle, in brain MRI image, cable insulation layer measurement, Real-time facial expression recognition, edge detection of river regime, Automatic Multiple Faces Tracking and Detection. Canny edge detection technique is used in license plate reorganization system which is an important part of intelligent traffic system (ITS), finds practical application in traffic management, public safety and military



department. It also finds application in medical field as in ultrasound, x-rays etc.

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