# A Review Paper on Image Segmentation Using Edge Detection Techniques and Threshold in MATLAB

Aarti Maan
NCCE, Israna, Panipat, India.

Dr. Sukhvir Singh
NCCE, Israna, Panipat, India.

**Abstract – Image segmentation is a process of partition of an image into meaningful regions. Image segmentation needs to segment the object from the background to read image properly and identify the content of the image carefully. It is the foundation of object recognition and computer vision. Edge detection is one of the most commonly used operation in an image analysis. There are more algorithms in the literature for enhancing and detecting edges than any other single object. Objects are subjects of interests in image and vision system. An edge is the boundary between an object and background. It indicates the boundary between overlapping objects. In this paper, the main aim is to study various different edge detections techniques which have great features. The basic aim is to detect different shape like triangle, rectangle, rhombus and circle etc. in an image using hough transform.**

**Index Terms – Image segmentation, Edge detection techniques, Threshold, Histogram, Hough Transform**.

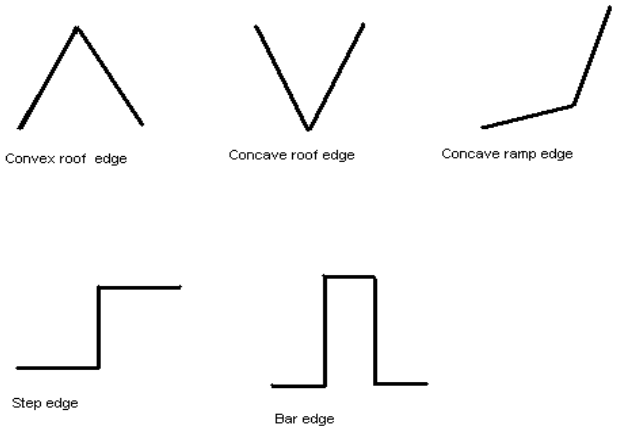
## 1. INTRODUCTION

Image segmentation is an important step inimage analysis. Segmentation process separate an image into different parts or objects. It is a process of distinguishing objects from the background. The four main

Approaches used for image segmentation are: Threshold technique, edge detection, Region-based and connectivity preserving relaxation methods.

In computer vision it is a process of partitioning a digital image into multiple segments. Set of pixels known as super pixels. The goal of segmentation is to simplify or change the representation of an image into something that is meaningful and easier to analyze. Most important technique from all of these is "Edge Detection". Edge detection is the part of image segmentation. It is a process of classifying and placing sharp discontinuities in an image is called the edge detection. In this image brightness changes sharply or formally are identified. These all points are organized under line segments called edges. Edge detection also aims to classify and place all discontinuities in an image. Noise and image both have high frequency, hence edge detection becomes more difficult. The main objective of various edge detection techniques and analyzing their performance is due to problems such as fake edge detection, noisy images, missing edge etc.

EDGE: Edge is basically a boundary between objects and background. It is the boundary between overlapping objects. It is seen at a place where an image has a strong intensity contrast. Edge could also be represented by a difference in color without any difference in intensity.




*C. STEPS IN EDGE DETECTION:*

Edge detection contain three steps: Filtering, Enhancement and Detection. The overview of these steps in edge detection are as follows.

1) Filtering: Images are often corrupted by random variations in intensity values is called noise. Some common types of noise are salt and pepper noise, impulse noise and Gaussian noise. Salt and pepper noise contains random occurrences of both black and white intensity values. However, there is a trade-off between edge strength and noise reduction. More filtering to reduce noise results in a loss of edge strength [4,5,6].

2) Enhancement: In order to facilitate the detection of edges, it is essential to determine changes in intensity in the neighborhood of a point. Enhancement emphasizes pixels

where there is a significant change in local intensity values and is usually performed by computing the gradient magnitude.

3) Detection*:* Many points in an image have a nonzero value for the gradient, and not all of these points are edges for a particular application. Therefore, some method should be used to determine which points are edge points. Frequently, threshold provides the criterion used for detection.

IMAGE GRADIENT: It is a directional change in the intensity or color in an image. Image gradients may be used to extract information from images.

HISTOGRAM: Histogram manipulation can be used for image enhancement. It works with digital image with grey levels in the range[0, L-1], that is a discrete function.

THRESHOLD: It is the simplest method of image segmentation. During the threshold process, individual pixels in an image are marked as "object" pixels if their value is greater than some threshold value(assuming an object to be brighter than the background) and as "background" pixels otherwise. This convention is known as Threshold.

CLUSTERING: Clustering is a process of grouping the objects those all members are working in the same way.

MATLAB: MATLAB stands for Matrix Laboratory. MATLAB was originally written to provide easy access to matrix software developed by the EISPACK projects. 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.

KEY FEATURES:

- High level language for visualization and application development.
- Interactive environment for iterative exploration, design and problem
- Mathematical functions solving for linear algebra, statistics, fourier analysis,

| | |
|---|---|
| -1 | 0 |
| 0 | -1 |

- Filtering and Built in graphics.
- Development tools for improving code quality.

APLICATIONS OF IMAGE SEGMENTATION:

In machine vision, medical imaging, surgery planning, virtual surgery simulation, face detection, intra surgery simulation, iris, finger print, face recognition, traffic control system.

## 2. EDGE DETECTION METHODS

Three most frequently used edge detection methods are used for comparison. These are (1) Roberts Edge Detection, (2) Sobel Edge Detection, (3) Prewitt edge detection (4) Kirsch Edge Detection (5) LoG edge detection , (6) Canny Edge Detection and (7) Marr-Hildreth Edge Detection.

### A. Roberts Edge Detection

The Roberts Cross operator performs a simple, quick to compute, 2-D spatial gradient measurement on an image. It thus highlights regions of high spatial frequency which often correspond to edges. In its most common usage, the input to the operator is a grayscale image, as is the output. Pixel values at each point in the output represent the estimated absolute magnitude of the spatial gradient of the input image at that point [1].

| | |
|---|---|
| 0 | 1 |
| -1 | 0 |

### B. Sobel Edge Detection

The Sobel edge detection method is introduced by Sobel in 1970. The Sobel method of edge detection for image segmentation finds edges using the Sobel approximation to the derivative. It precedes the edges at those points where the gradient is highest. The Sobel technique performs a 2-D spatial gradient quantity on an image and so highlights regions of high spatial frequency that correspond to edges. In general it is used to find the estimated absolute gradient magnitude at each point in n input grayscale image. In conjecture at least the operator consists of a pair of 3x3 complication kernels as given away in under table. One kernel is simply the other rotated by 90 degrees. This is very alike to the Roberts Cross operator [1,4,5,6].

| | | |
|---|---|---|
| 1 | 2 | 1 |
| 0 | 0 | 0 |
| -1 | -2 | -1 |

| | | |
|---|---|---|
| -1 | 0 | 1 |
| -2 | 0 | 2 |
| -1 | 0 | 1 |

C. Prewitt edge detection

The Prewitt edge detection is proposed by Prewitt in 1970 [1]. To estimate the magnitude and orientation of an edge Prewitt is a correct way. It is limited to 8 possible directions; however knowledge shows that most direct direction estimates are not much more perfect. This gradient based edge detector is estimated in the 3x3 neighborhood for eight directions. All the eight convolution masks are calculated. One complication mask is then selected, namely with the purpose of the largest module. Prewitt detection is slightly simpler to implement computationally than the Sobel detection, but it tends to produce somewhat noisier results [1,2].

| | | |
|---|---|---|
| 1 | 1 | 1 |
| 0 | 0 | 0 |
| -1 | -1 | -1 |

| | | |
|---|---|---|
| -1 | 0 | 1 |
| -1 | 0 | 1 |
| -1 | 0 | 1 |

D. Kirsch Edge Detection

Kirsch edge detection is introduced by Kirsch (1971). The masks of this Kirsch technique are defined by considering a single mask and rotating it to eight main compass directions: North, Northwest, West, Southwest, South, Southeast, East and Northeast. The masks are distinct as follows:

The edge magnitude is defined as the maximum value found by convolution of each mask with the image. The direction is defined by mask that produces the maximum magnitude. Example, mask k0 corresponds to a vertical edge, while mask k5 corresponds to a diagonal edge. Notice that the last four masks are actually the same as the first four, but flipped about a central axis.

E. LoG edge detection

The Laplacian of Gaussian (LoG) was proposed by Marr (1982). The LoG of an image f(x,y) is a second order derivative defined as, It has two effects, it smoothers the image and it computes the Laplacian, which yields a double edge image. Locating edges then consists of finding the zero crossings between the double edges. The Gaussian filtering is combined with Laplacian to break down the image where the intensity varies to detect the edges effectively.

| | | |
|---|---|---|
| 0 | -1 | 0 |
| -1 | 4 | -1 |
| 0 | -1 | 0 |

F. Canny Edge Detection.

In industry, the Canny edge detection technique is one of the standard edge detection techniques. It was first created by John Canny for his Master's thesis at MIT in 1983, and still outperforms many of the newer algorithms that have been developed. To find edges by separating noise from the image before find edges of image the Canny is a very important method. Canny method is a better method without disturbing the features of the edges in the image afterwards it applying th

*G. Gaussian Edge Detectors*

It reduces the noise by smoothing the image, it gives better results in noisy environment. The noteworthy operators are Canny and ISEF (Shen-Castan). It is very time consuming and very complex for computation.

## 3. LITERATURE SURVEY

Several works related to our work present the efficient resources allocation in image segmentation using edge detection as described below:

1. S.Lakshmi,Jeppiar [1] He done survey on various image segmentation techniques. His plan was to design a novel approach for edge detection and object recognition.
2. Y.Ramdevi, et.al[2] were concerned about the many techniques of using edge detection operators. They described interaction between image segmentation and object recognition using Sobel, Prewitt, Robert, Canny techniques.
3. Shikha Rani Dhiman[3] She has done all comparative studies applied using various techniques of image segmentation.
4. Ponam Dhankar[4] She showed the final result from all experiments of edge techniques. It is observed from LoG and Canny edge detector which produce almost same result. Canny result is superior than all other.
5. Srinivas B.L Hemalatha[5] He described all detection techniques which are based on discontinuity levels. So, all detection are available in the literature.
6. Preeti Budhwar[6] She used Hough Transform. This detect both straight line and circle. But this cannot be applied with unknown radius. One another problem

arises when it detects the corner portion of an image, if the corner is semi-circle. It detect semi circle as circle.

7. METHODS RESULTS

| | |
|---|---|
| 1.Roberts Edge Detection | Deviated from the original Image |
| 2.Sobel Edge Detection | Deviated from the original Image |
| 3.Prewitt edge detection | Deviated from the original Image |
| 4.Kirsch Edge Detection | Almost same as original Image |
| 5.LoG edge detection | Almost same as original Image |
| 6.Canny Edge Detection | Almost same as original Image |

Table 1. Comparison of different Edge Techniques.

REFERENCES

[1] S.Lakshmi, Jeppiar Engineering college, Chennai, India, "A study of Edge Detection Techniques for Segmentation Computing Approaches", IJCA special Issue on "Computer Aided Soft Computing Techniques for Imaging and Biomedical Application",2010.

[2] Y.Ramdevi, T.Sridevi, B.Poornima, B.Kalyani,"Segmentation and object recognition", (IJCSIT) International Journal of Computer Science and Information Technology.,Vol 2, Vol 6, December 2010.

[3] Rafall C. Gonzalex, Richard E.Woods, Image segmentation in the book titled Digital Image Processing chapter 10, page no>589-664,second Edition.

[4] Shikha Rani Dhiman,"A Survey of Image Segmentation Techniques", International Journal on Recent and Innovation Trends in Computing and Communication,Volume:2, Issue:9,sep 2014.

[5] Poonam Dhankar,(IJCSMC) "International Journal of Computer Science and Mobile Computing,Vol.2,Issue:7 July,2013,pg 86-92.

[6] Srinivas B.L[1] Hemalatha,"Image segmentation techniques",Issue: 7 october,2015.

[7] Preeti Budhwar , "Image Segmentation in terms of Edge Detection approach using Clustering and Threshold", International Journal of Computer Science and Information Technology, June 2015.