EDGE DETECTION TECHNIQUES FOR MAMMOGRAM IMAGES ANALYSIS

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Abstract : Edge detection plays a vital in image processing. For Mammogram image analysis main functional blocks used to detect the cancer or non-cancerous images based on the preprocessing, segmentation, feature extraction and classification methods. To get accurate result one should get exact segmented image for that these edge detection methods will support. In this paper we have studied and analyzed Canny, Prewitt, Log ,Sobel and Robert edge detection methods. With active contour segmentation using five edge detecting technique and without segmentation the same five edge detection methods. Out of which canny detector giving best result for all mammogram images as well as normal other gray and colour images. We have used for this analysis MIAS database 322 image used to analyze this process using MATLAB 2018a Software.

Keywords: Canny, Edge Detection, LoG, Prewitt, Robert, Sobel, etc.

I. INTRODUCTION

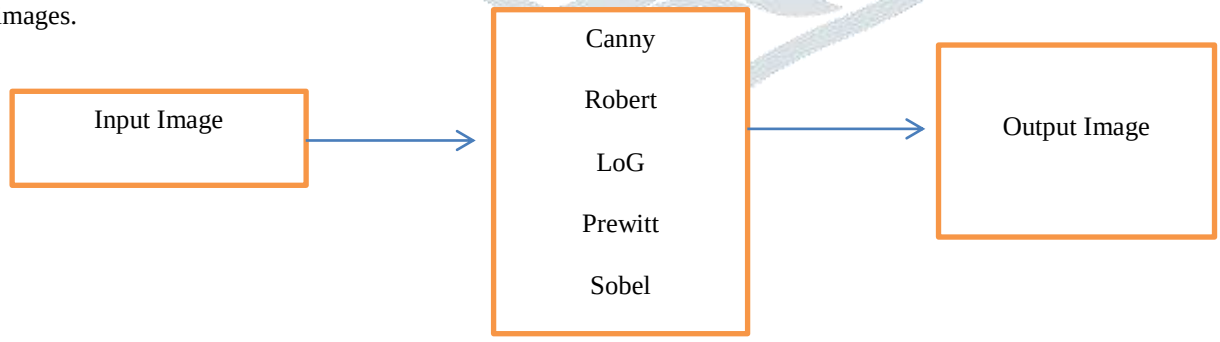
An *edge* can be defined as a boundary between two image regions having distinct characteristics according to some feature (e.g., gray level, color, or texture). In this paper, we focus primarily on edges in grayscale 2D images, which are usually associated with a sharp variation of the intensity function across a portion of the image.

Edge detection methods usually rely on calculations of the first or second derivative along the intensity profile. The first derivative has the desirable property of being directly proportional to the difference in intensity across the edge; consequently, the magnitude of the first derivative can be used to detect the presence of an edge at a certain point in the image. The sign of second derivative can be used to determine whether a pixel lies on the dark or on the bright side of an edge. Moreover, the zero crossing between its positive and negative peaks can be used to locate the center of thick edges.

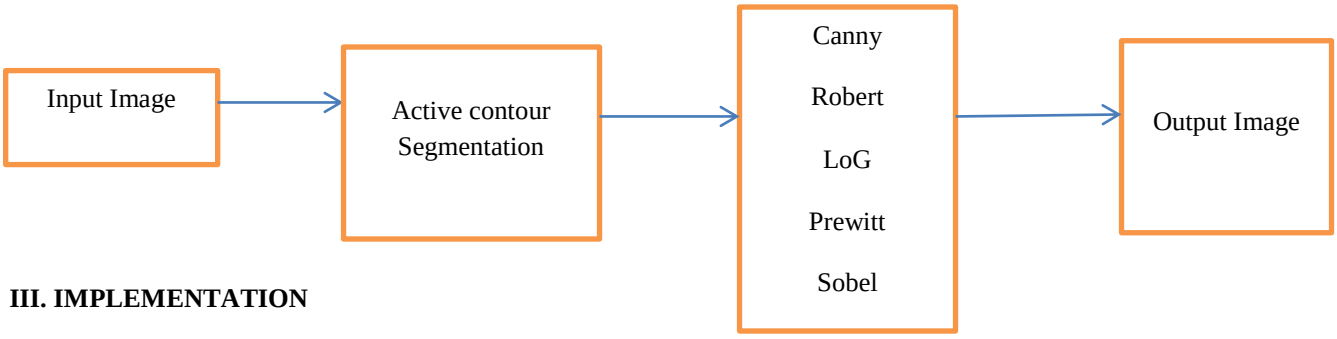
Segmentation is one of the most crucial tasks in image processing and computer vision. Image segmentation is the operation that marks the transition between *low-level image processing* and *image analysis*: the input of a segmentation block in a machine vision system is a preprocessed image, whereas the output is a representation of the regions within that image. This representation can take the form of the boundaries among those regions when edge-based segmentation techniques are used or information about which pixel belongs to which region Once an image has been segmented, the resulting individual regions can be described, represented, analyzed, and classified with techniques.

II. METHODOLOGY

First Methodology: Taking an input image and using one at a time different types of edge detection technique using to get the edge detected output images.



Second Methodology: Taking an input image ,segmented the image and using different edge detection methods we got the edge detected output images



III. IMPLEMENTATION

3.1. Roberts Edge Detection

The Roberts edge detection is introduced by Lawrence Roberts (1965). It performs a simple, quick to compute, 2-D spatial gradient measurement on an image. This method emphasizes regions of high spatial frequency which often correspond to edges. The input to the operator is a grayscale image the same as to the output is the most common usage for this technique. Pixel values in every point in the output represent the estimated complete magnitude of the spatial gradient of the input image at that point.

-1	0
0	+1

G_x

0	-1
+1	0

G_y

3.2. Sobel Edge Detection

The Sobel edge detection method is introduced by Sobel in 1970 (Rafael C.Gonzalez (2004)). 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 gray scale image. In conjecture at least the operator consists of a pair of 3x3 complication kernels as given away in under table. ne kernel is simply the other rotated by 90^0. This is very alike to the Roberts Cross operator.

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

G_x

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

G_y

3.3. Prewitt Edge Detection

The Prewitt edge detection is proposed by Prewitt in 1970 (Rafael C.Gonzalez [1]. To estimate the magnitude and orientation of an edge Prewitt is a correct way. Even though different gradient edge detection wants a quite time consuming calculation to estimate the direction from the magnitudes in the x and y-directions, the compass edge detection obtains the direction directly from the kernel with the highest response. 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.

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

G_x

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

G_y

Prewitt detection is slightly simpler to implement computationally than the Sobel detection, but it tends to produce somewhat noisier results.

3.4. 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,

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

It has two effects, it smoothes the image and it computes the Laplacian, whch yields a doubleedge image. Locating edges then consists of finding the zero crossings between the double edges. The digital implementation of the Laplacian function is usually made through the mask below,

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

G_x

-1	-1	-1
-1	8	-1
-1	-1	-1

G_y

The Laplacian is generally used to found whether a pixel is on the dark or light side of an edge.

3.5. 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 the tendency to find the edges and the serious value for threshold.
The algorithmic steps are as follows:

- Convolve image f(r, c) with a Gaussian function to get smooth image
  f^(r, c). f^(r, c)=f(r,c)*G(r,c,6)
- Apply first difference gradient operator to compute edge strength then edge magnitude
- and direction are obtain as before.
- Apply non-maximal or critical suppression to the gradient magnitude.
- Apply threshold to the non-maximal suppression image.

Unlike Roberts and Sobel, the Canny operation is not very susceptible to noise. If the Canny detector worked well it would be superior.

IV. EXPERIMENTAL RESUTS

Original input image & Segmented image

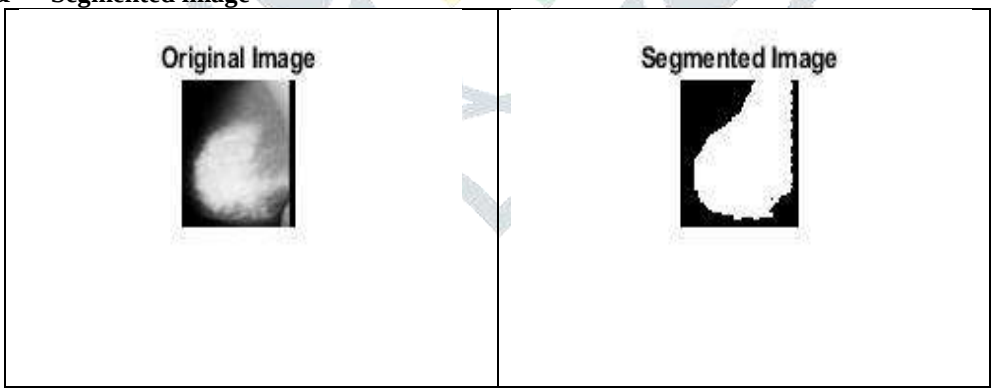


figure (1)

With active contour segmentation using five types of edge detection output Mammogram images

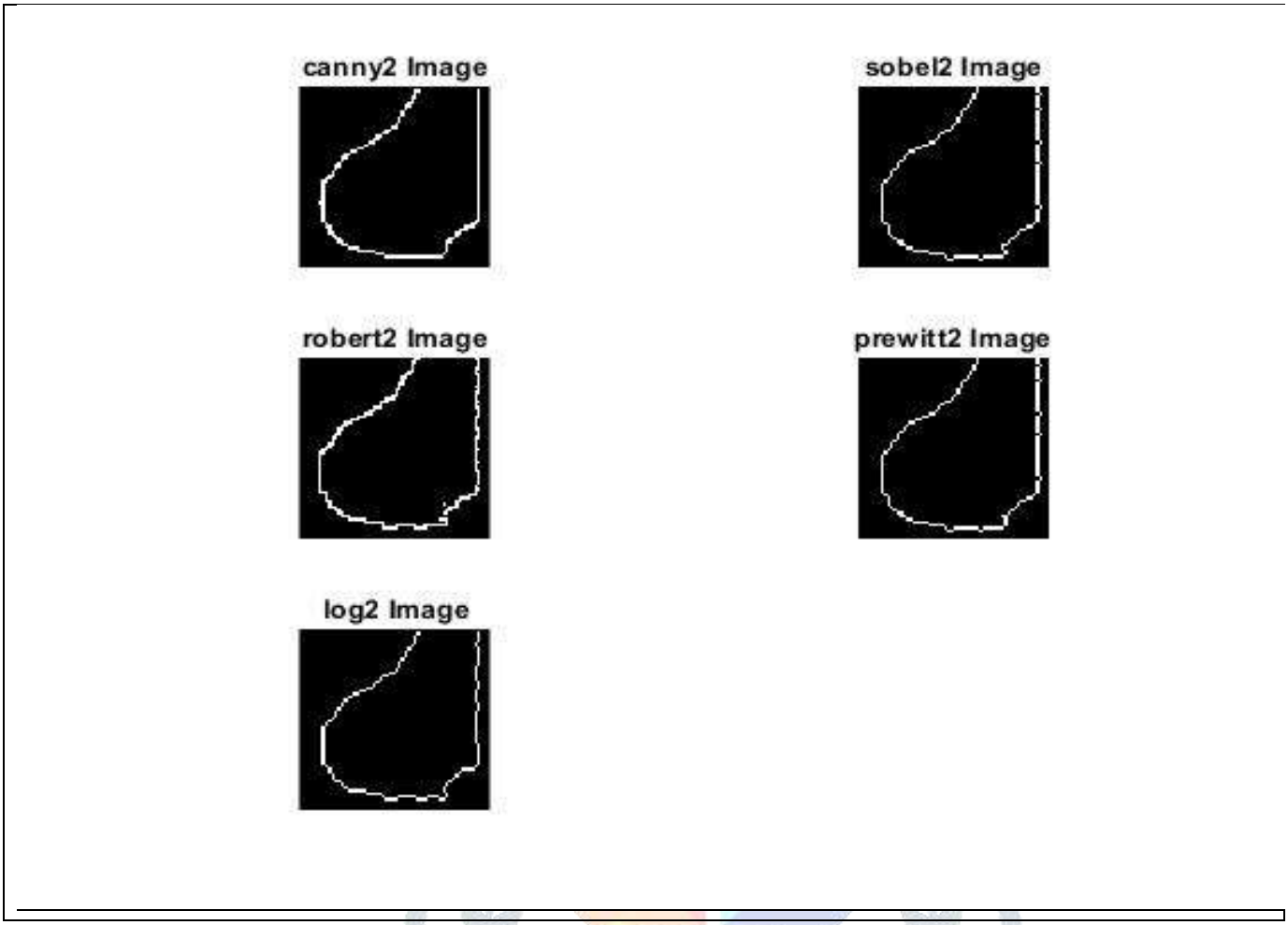


figure (2)

Without segmentation five types of edge detection output Mammogram images

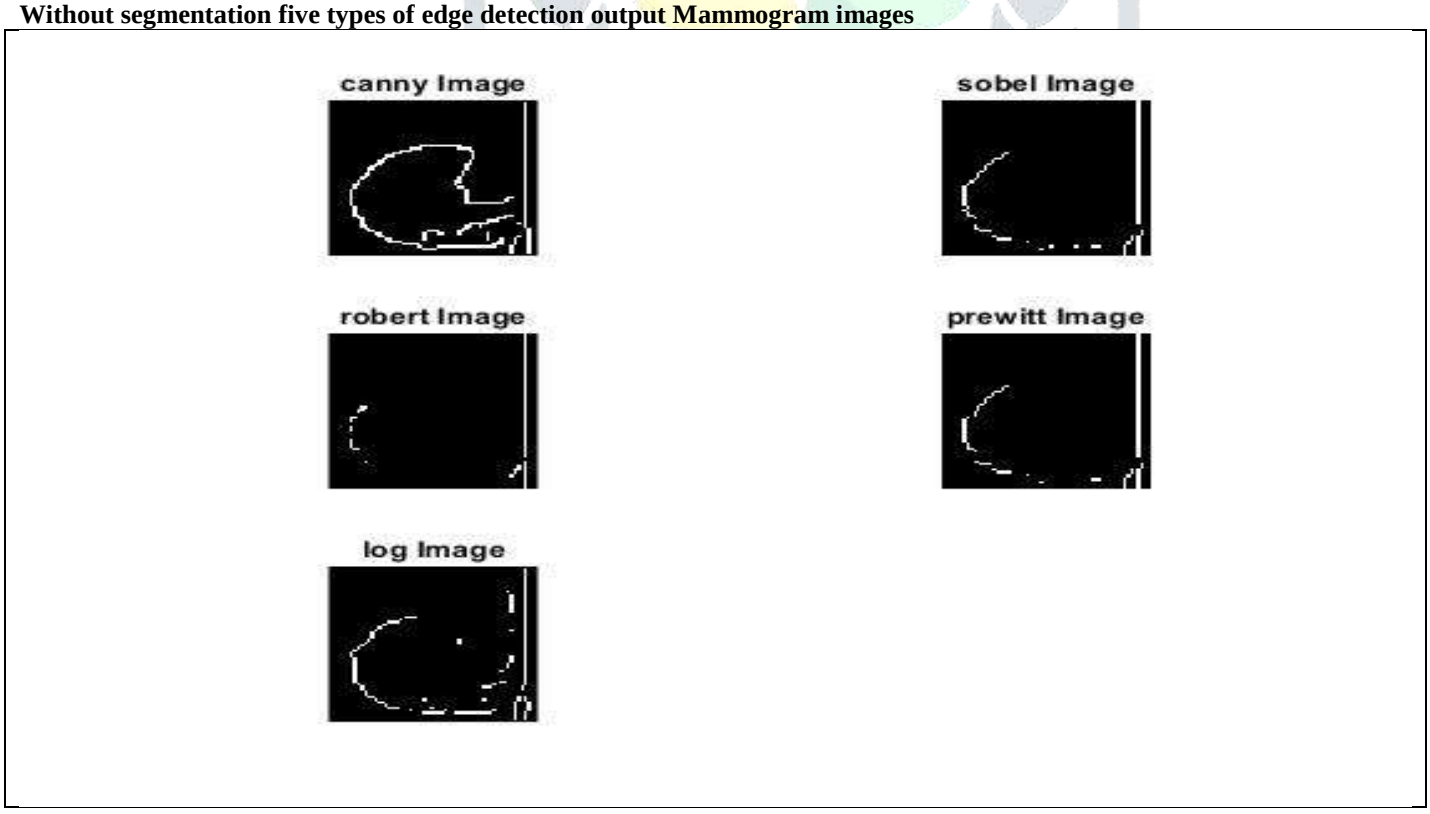


figure (3)

Original Image, Gray level image and Segmented Image

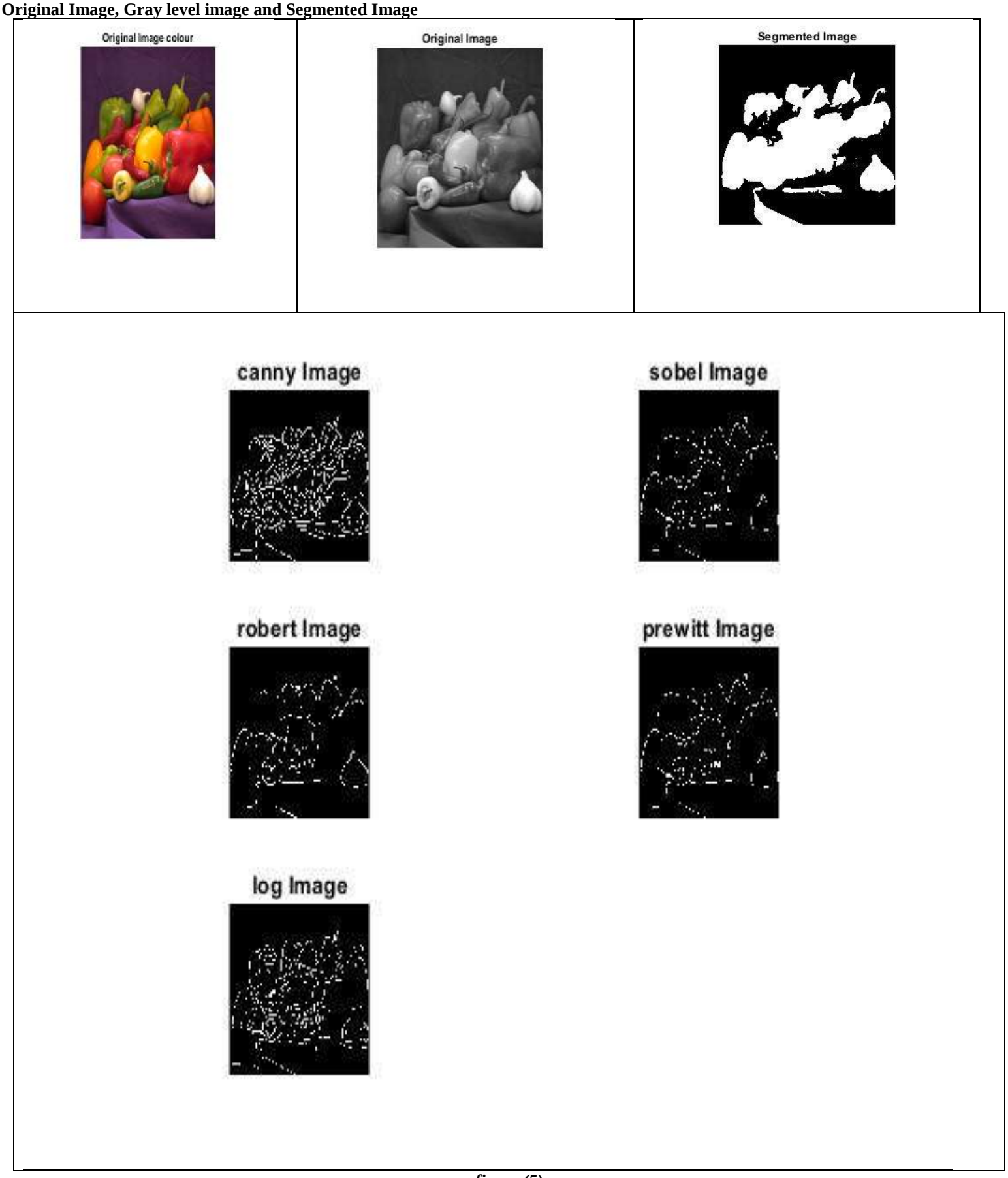


figure (5)

Without segmentation five types of edge detection output Mammogram images

With active contour segmentation five types of edge detection output Mammogram images

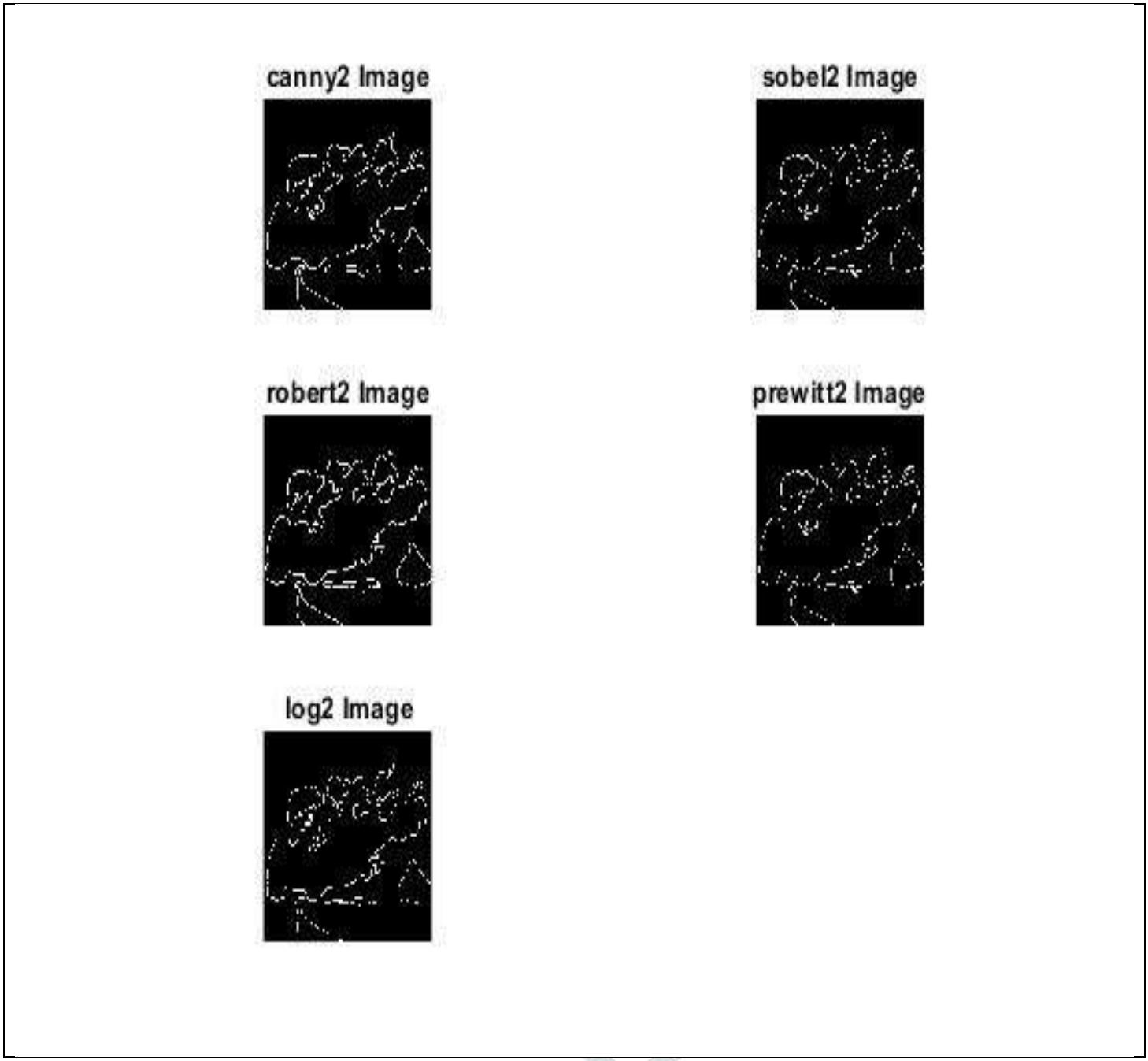


figure (6)

V. CONCLUSION

In this paper edge detection analysis work has been carried using MIAS Database 320 image. **The observation carried out by various edge detection techniques with active contour segmentation and without segmentation both the cases canny edge detection is giving better results comparatively with other methods**. We tested mammogram images, colour image and normal gray images also using MATLAB2018a software. We have tested without segmentation and with segmentation also in both the cases. Canny edge detector is giving all the edges are available in an image. Compared with sobel, Robert, log, prewitt edge detectors Canny edge detector is the best one.

Future scope: Further analysis has to be carried out to find out the better segmentation methods with low processing time to get the better accuracy, sensitivity and selectivity.

REFERENCES

[1]. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", 3rd Edition, Prentice Hall of India, New Delhi, India, 2009.
[2]. Madhuri A. Joshi, "Digital Image Processing - An Algorithmic Approach", Prentice Hall of India, New Delhi, India, 2010.
[3]. J. M. S. Prewitt, "Object Enhancement and Extraction", Picture Processing and Psychopictorics, Academic Press, New York, 1970.
[4]. J. Canny, "A Computational Approach for Edge Detection", IEEE Trans. on Pattern Analysis and Machine Intelligence, Vol. 8, No. 6, pp. 679-698, 1986.
[5]. X. Yu and T. D. Bui, "Robust Estimation for Range Image Segmentation and Reconstruction", IEEE Trans. on Pattern Analysis and Machine Intelligence, Vol. 16, No. 5, pp. 530-538, 1994.

[6]. K.Nagaiah, M.Ravi Babu "Advanced Enhancement Micro calcification in Mammography", International Journal of Science and Research, Volume 2 Issue3, March 2013. ISSN :2319-7064.
[7]. K.Nagaiah, G.Ashok Kumar, "Tracking the moving object and morphological reconstruction of video sequences by using Gradient and HSV process" International Journal of Reviews on Recent electronics and computer science/October 2013/Volume -1/ Issue-6/1176-1183.ISSN 2321-5461.
[8]. K.Nagaiah**,** Dr. K. Manjunathachari, Dr.T.V.Rajinikanth, " Efficient Image Enhancement Techniques For Micro Calcification Detection In Mammography" International journal of Electrical and Electronics Engineers (IJEEE) Vol. No7 Issue 2, July- December 2015.
[9]. K.Nagaiah**,** Dr. K. Manjunathachari, Dr.T.V.Rajinikanth, "Mammogram Image Analysis for Micro calcification Detection with Mammography" Global Journal of Pure and Applied Mathematics (GJPAM) ISSN 0973-1768 Volume 11,Number 2 (2015). **Scopus Indexed Journal**
[10]. B. Sumanjali K. Nagaiah B. Anitha "Implementation of Automatic Retina Exudates Segmentation Algorithm for Early Detection with Low Computational Time" International Journal Of Engineering And Computer Science ISSN: 2319-7242 Volume 5 Issue 10 Oct. 2016, Page No. 18584-18588.
[11].Mathswork.com
[12]. Digital Image Processing using MATLAB and Opencv by Vipula Singh
[13]. Digital Image Processing using by S.Jayaraman S, Esakkairajan and T. Veerakumar.