

# **A Novel Approach with Various Existing Edge Detection Techniques for Medical Imaging Modalities**

By

1<sup>st</sup> Yogesh Kumar Gupta

1<sup>st</sup> Department of Computer science, Banasthali Vidhyapith-304022,Jaipur, Rajasthan (INDIA)  
[yogeshgupta1005@gmail.com](mailto:yogeshgupta1005@gmail.com)

## **ABSTRACT**

In the current era to make the image more meaningful and easy to analyze, it is necessary to modify and simplify its representation through the segmentation. Segmentation is a process to separates the digital image into multiple segments (set of pixels) and each segment possesses different features such as texture, color, intensity, special location and many statistical properties. It is a way to interpret an image in detail. In image processing and pattern recognition, the edge detection techniques play a very important role to visualize the ROI (Suspicious region) and used as a preprocessing step. Edges are the most essential part in the image because an image contains most important features such as corner, lines, curves etc on their edges. The edge detection in an image reduces the amount of data by filtering out useless information and preserves necessary properties. So, it is very important to choose a robust edge detection technique to obtain the best results in all the conditions. In this paper we have tried to proposed a novel edge detection technique that give a comparative better results than the other existing some commonly use edge detection techniques such as Sobel, Prewitt, Roberts, LoG and Canny.

## **Keywords**

Segmentation, Imaging Modalities, ROI, Edge detection technique.

## **1. INTRODUCTION**

Image processing is a method to acquire an enhanced image by converting it into digital form in order to extract some meaningful information from it by performing many operations on an image. It takes image as an input and output may the features related to that image. It involves basically three steps- image acquisition with the help of acquisition tool, manipulation and analysis of the image and finds result on the basis of the image analysis. The purpose of the image processing is visualization of the image objects, image restoration and sharpening to create a better image, image retrieval to find ROI, measurement of various objects in the image and image recognition to distinguish image objects.[5]

Image analysis is the process of extracting meaningful information from an image by using image processing

techniques and the final result of the image analysis is a numerical data rather than an image. Image analysis process involves the following phases such as image acquisition, image pre-processing, image segmentation, feature extraction and feature selection, classification and result evaluation. Each phase has its own interpretation so that they are differing from another phases. In further we are going to elaborate all these phases in detail.

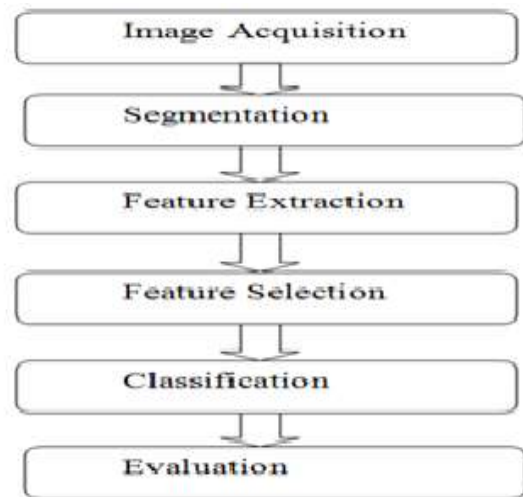


**Fig 1: Model of image processing [3]**

**1) Image acquisition-** image acquisition is the very first step of image processing. High quality images are collected and stored in a media for further diagnosis. Sampling and quantization processes are used to convert the continuous sensed data into a digital form. [3]

**2) Pre processing-**Real time images are collected from publically available database. These are raw images having various types of noise. so there is a need of suitable pre-processing methodologies to enhance the image quality such as increasing the contrast, resizing an image, equalized the histogram that means a frequency lebel and remove all the unwanted information and noise.[3]

**3) Segmentation:-** It is a process to separates the digital image into multiple segments (set of pixels) and each segment possesses different features such as texture, color, intensity, special location and many statistical properties.The main

objective of the segmentation to get the particular specific region of the image.

**4) Feature extraction:-** It is the process of analyzing the images and objects then extract all the important feature or attributes that represents the objects of different classes. We can say that we join the attributes or features to make the new diminished value set.

**5) Feature selection:-** It is the process of selecting the features or attributes that are very relevant. The goal of the selection process is to remove the irrelevant and redundant feature or attribute which increase the accuracy of prediction and reduced the computing time that gives the best performance.

**6) Classification:-** It is a very important task for the images to retrieve the knowledge which helps medical specialists in process of decision making. So there are different kinds of classification methods available, first one is the texture classification technique which is used for image processing to identify the various regions of image on the basis of texture properties. Second one is neural network classification techniques play an important role with including supervised and unsupervised technique. The last one is data mining classification technique, mining means to extract the hidden, useful knowledge from the vast amount of data. It uses statistical, machine learning, virtualization and other manipulation techniques to extract the knowledge.[3]

**7) Evolution:-** It is the process to evaluate the finally classified data on the basis of computational parameters that shows the accuracy factor of the computation.

Among all the above described phases we mainly concern further about to proposed a new method of edge detection which will give the better result than the existing edge detection technique used in image segmentation to show the structure, shape and texture of the image.

## 2. REVIEW OF LITERATURE

Jamil A. M. Et al.(2012). [1] Authors compares two segmentation techniques first is Otsu thresholding (based on similarity approach) and second is Canny edge detection (based on discontinuity approach) and tests their correctness and stability on variety of medical and other types of images. For the segmentation purpose these two algorithms are best but for the endoscopic images canny algorithm is more suitable because in these images objects are not clearly separable from the background.

R. Yogamangalam and B. Karthikkeyan. (2013). [9] Have studied the most commonly used segmentation techniques

such as edge detection, model based, thresholding, clustering etc and discuss its advantages as well as disadvantages. Authors also mention the Markov Random Field (MRF) is the best method for denoisation of images and thresholding is the simplest and comparatively fast method for the image segmentation and segmentation techniques varies from application to application.

Singh P. and Chadha S.R. (2013). [7] The study suggested a novel approach to divide the image into multiple pieces to get more efficient vision of the image. They adopt one of the segmentation technique based on edge detection of the image present in the background and foreground. According to their suggested approach, after having the edge detection, dilation is applied over it from which is correctness is achieved for all type of images but stability is not achieved in the case of .png format.

Abubakar F. M. (2013). [6] Author presents this paper on Global thresholding segmentation technique on the noisy images by using MATLAB software. With the help of this techniques images corrupted with noise such as Salt, Pepper and Gaussian firstly converted into grayscale and than by using this technique objects of these images will successfully removed from the background.

Sambasivarao Ch. and Naganjaneyulu V. (2014). [8] Authors proposed a novel approach of boundary detection and image segmentation which is based on one of the common properties of image named as perceptual organization model. This work has to be proven for the outdoor images for their background recognition. The author's aim is to recognize the strictly structured objects (combination of constituent parts) to get the accurate and efficient segmented image.

A. Manikannan and J. SenthilMurugan. (2015). [10] this paper firstly discuss on the some commonly used segmentation techniques as well as their advantages and drawbacks and proposed a technique based on the watershed algorithms to remove the limitation of the existing system. In existing system there is no proper way defined to process and alter an image in a desired manner. The proposed system provides image modification according the specification for the future accuracy.

Thakur A. K. and Madhusudan. 2016. [12] Paper provides an overview on image segmentation techniques and principle of image segmentation with their major application areas. To achieve higher accuracy in result of image segmentation some methods with common attributes will combine because there is not any perfect image segmentation method.

Conclusion of the survey is that the canny gives the better result than the other existing edge detection technique in reference to the line, curve and shape of an object in an image. But in canny the edges are breakable in the form of separate point, so it is very difficult to identify the exact shape and curve of the ROI in an image. Due to this problem we have

proposed a new method which will give the better result in the reference of unbreakable lines of object in an image.

### 3. IMPLEMENTATION

Image segmentation techniques are basically categorized into two categories: discontinuity approach (edge- based) and similarity approach (region- based) based on the two basic properties of the image. Segmentation method which is based on the discontinuity property of pixel, separate the image simply based on the sudden changes in intensity and it includes boundary or edge based techniques and the segmentation method based on similarity and homogeneity, partition the image by constructing the groups which are very analogous to each other and it uses methods like Thresholding, merging, region splitting and region growing.

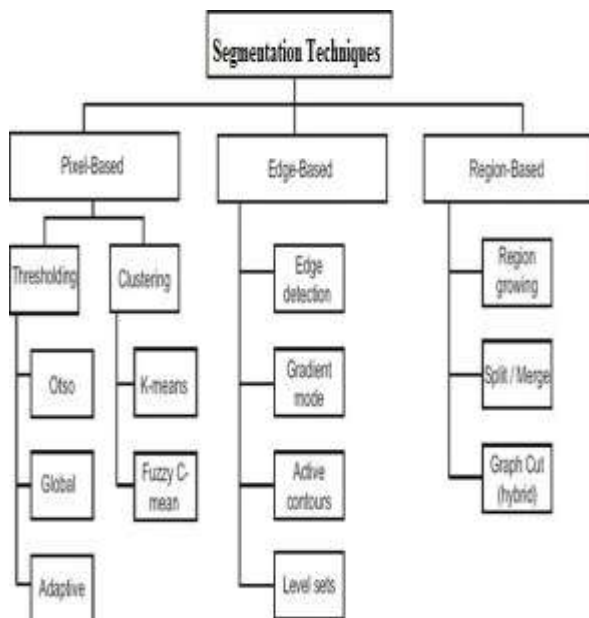


**Fig 2: segmentation techniques [11]**

**Edge based-** Using edge detection operators this method used to find the edge information in the image and transform original image into edge images. Pixels between boundary of two regions form edge. Generally filtering, enhancement and detection of edge points are the three main steps to carry out edge detection process. [14] Edges are the most essential part in the image because an image contains most important features such as corner, lines, curves etc on their edges. Edge detection decreases the amount of data size to be processed and sort out the useless information and save essential structural properties in the image. Gradient based 1<sup>st</sup> order derivative (sobel operator, Prewitt operator, Robert operator) and laplacian based 2<sup>nd</sup> order derivative (Laplacian of

Gaussian, canny edge detection) are the two commonly used methods for edge detection. [15]

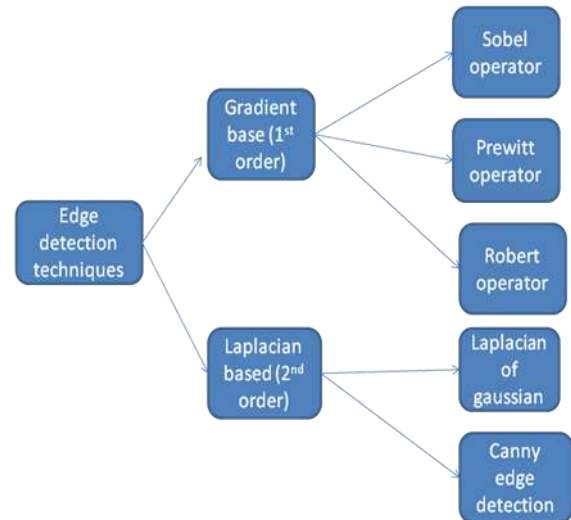


**Fig 3: edge based segmentation techniques [15]**

1) Sobel operator-this operator is used to detect the edge strength and edge direction in the image.  $BW = \text{edge}(I, \text{'sobel'})$  -is the formula for the sobel method and  $BW = \text{edge}(I, \text{'sobel'}, \text{thresh})$  – it is for the threshold sensitivity for thesobel method. All the edges with lower value than thresh are ignored and if the thresh is not given than edge selects the value automatically. Sobel is used to obtain the gradient measurement of the image from the original with the help of convolution mask of sobel operator. It is 3x3 convolution kernels.[18]

2) Prewitt operator-it is a gradient based edge detector operator and approximate method to calculate the orientation and magnitude of an edge and estimate in the 3x3 neighborhood for 8 directions.  $BW = \text{edge}(I, \text{'Prewitt'})$  – it is a formula for the Prewitt method and  $BW = \text{edge}(I, \text{'Prewitt'}, \text{thresh})$ - calculates the thresholding sensitivity of the Prewitt method. All the edges withlower value than thresh is ignored and if the thresh is not given the method automatically selects the value of thresh.[18]

3) Robert operator- it is a gradient based edge detector operator and provide a 2D spatial gradient measurement of an image and has 2x2 convolution mask.  $BW = \text{edge}(I, \text{'Roberts'})$  – formula for the Robert operator and  $BW = \text{edge}(I, \text{'Roberts'}, \text{thresh})$  gives the thresholding sensitivity of the Roberts method. All the edges that are not stronger than thresh is ignored and if the thresh is not given the method automatically selects the value of thresh.[18]

4) Laplacian of Gaussian (LoG)-  $BW = \text{edge}(I, \text{'log'})$  – is the MATLAB formula for the log operator and  $BW = \text{edge}(I, \text{'log'}, \text{thresh})$  tells the thresholding sensitivity of the log method. All the edges that are not stronger than thresh is ignored. Log of an image is a second order derivative and the

digital implementation of the laplacian function is done by using the mask. It firstly smoothes the image and then computes laplacian.[18]

5) Canny edge detection-BW= edge(I, 'canny') – formula for the canny operator and BW=edge (I, 'canny', thresh) specifies the thresholding sensitivity of the log method. In canny operator thresh has two elements- first is low threshold and second is high threshold. Canny edge detector is a widely acceptable method in image processing. It is very robust method to detect edges and less adaptable to noise and find edges in the image by removing noise from the input image.It takes less time than the other edge detection methods and extract features from the image without destroying image features. [18]

**Proposed Edge detection methodology:-** As we know that edges are very crucial to identify the ROI of an object in an images. So for that we have proposed a method that gives the better result in the reference of unbreakable lines of object in an image. This method will further be described in the below edge detection model.

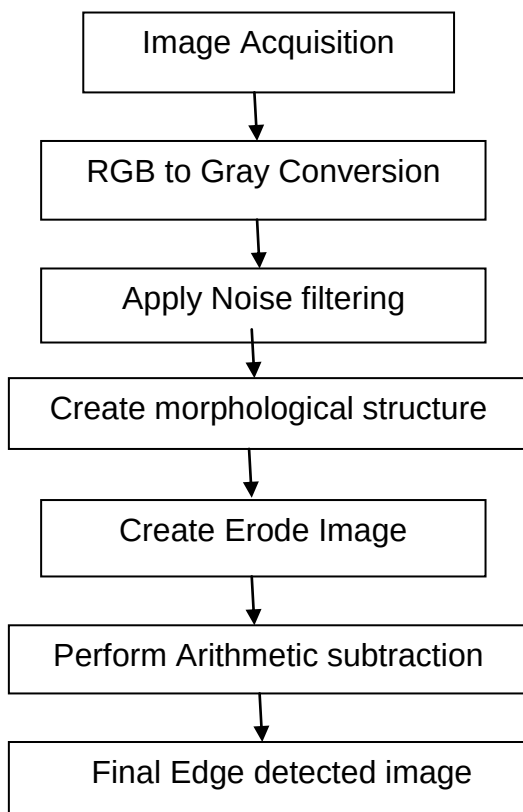


**Fig 4: block diagram of Proposed Edge detection model**

## 4. RESULT AND DISCUSSION:-

**4.1 Experimental environment:** - the various edge detection techniques are experimented in this section on different-different images. Tenimage Samples were

experimented with the help of MATLAB R2013a on Intel(R) Core(TM) i3-3210 CPU @ 3.20 GHz processor, 4.00GB RAM and 32-bit operating system. Here we choose three samples to show the results. Results may be varies depending on the machine configuration.

### 4.2 Results

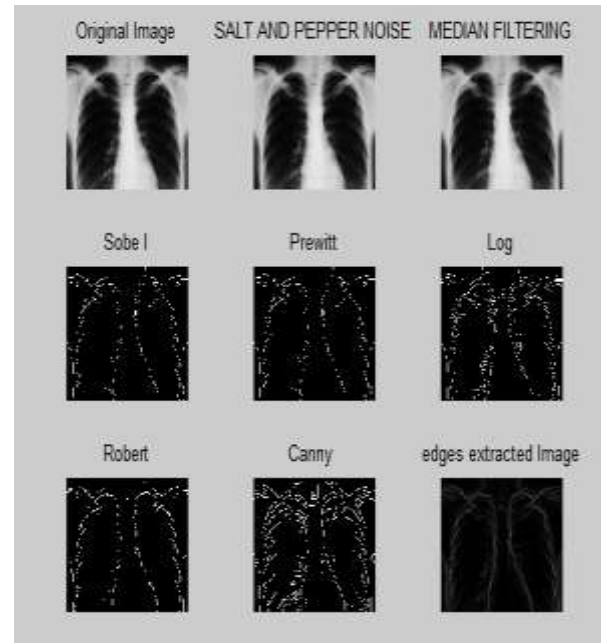


**Fig 5: Chest X-ray Image**

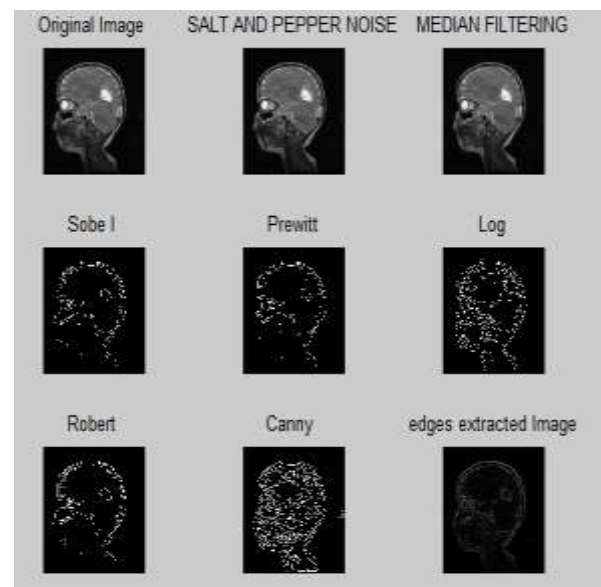


**Fig 6: Brain MRI Image**

**4.3 Discussion:** -firstly we have acquired 20 medical images and then perform the preprocessing task to remove the noises by using the median filter. Secondly applied different existing edge detection operator such as Sobel, Roberts,

Prewitt, LoG and Canny and new proposed method to detect the edges of images and the results are shown above. The edge detection of an image reduces the amount of data to be processed while preserving the main structural properties of an image. In this experimental result the proposed method give the better result in the reference of unbreakable lines of object in images; due to this we can easily identify the ROI of an image.

## 5. CONCLUSION

To recognize an image object, edge detection is the initial step in image processing. It is very important to find out the merits and demerits of various edge detection techniques before using them. In this paper we have proposed an edge detection method which will give the better result than the existing edge detection operators in the reference of unbreakable lines of object in images along with their experimental analysis. Due to this we can easily identify the exact shape and curve of the ROI in images.

## 6. REFERENCES

- [1] Jamil A. M. Saif, Al-Kubati A. A. M, Hazaa A. S, Al-Moraish M. Image segmentation using Edge Detection and Thresholding. The 13<sup>th</sup> International Arab Conference on Information Technology (ACIT). 2012; ISSN: 1812-0857.
- [2] M. Ravi, B. Basavaprasad. A Comparative Study on Segmentation Methods for Medical Imaging. Proceeding of NCRIET & Indian J. Sci. Res. 2015; 12(1):302-306, ISSN (ONLINE): 2250-0138.
- [3] Tamilselvan K. S, Murugesan G, Kandasamy K. A Novel Image Segmentation Algorithm for Clinical CT Images using Wavelet Transform, Curvelet Transform and Multiple Kernel FCM. Applied Mathematics Science, HIKARI Ltd. 2015. Vol. 9, no. 2351-2362.
- [4] Usha, Kumar S. A Survey on Different Image Segmentation Techniques. International Conference on Technologies for Sustainability- Engineering, Information Technology, Management and the Environment. 2015; ISBN: 978-81-931039-7-5.
- [5] Chandrakala M, Devi P. D. Threshold Based Segmentation Using Block Processing. International Journal of Innovative Research in Computer and Communication Engineering. 2016; Vol. 4, ISSN (ONLINE): 2320-9801, DOI: 10.15680/IJIRCC.2016.0401050.
- [6] Abubakar F. M. Study of Image Segmentation using Thresholding Technique on a Noisy Image. International Journal of Science and Research (IJSR), India. 2013; Vol. 2, Issue. 1, ISSN (ONLINE): 2319-7064.
- [7] Singh P, Chadha S.R. A Novel Approach to Image Segmentation. International Journal of Advanced Research in Computer Science and Software Engineering. 2013; Vol. 3, ISSN: 2277 128X.
- [8] Sambasivarao Ch, Naganjaneyulu V. An Efficient Boundary Detection and Image Segmentation Method Based on Perceptual Organization. International Journal of Computer Trends and technology (IJCTT). 2014; Vol. 7, ISSN: 2231-2803.
- [9] R. Yogamangalam, B. Karthikeyan. Segmentation Techniques Comparison in Image Processing. International Journal of Engineering and Technology (IJET). 2013; Vol. 5, ISSN: 0975-4024.
- [10] A. Manikannan, J. SenthilMurugan. A Comparative Study about Region Based and Model Based using Segmentation Techniques. International Journal Innovative Research in Computer and Communication Engineering. 2015; Vol. 3, Issue. 3, ISSN (ONLINE): 2320-9801.
- [11] S. Lakshmi, V. Sankaranarayanan. A Study of Edge Detection Techniques for Segmentation Computing Approaches. International Journal of Computer Applications. 2010.
- [12] Thakur A. K, Madhusudan. Image Segmentation: A Comparative Study. International Journal of Advances in Computer Science and Technology. 2016; Vol. 5, No. 6, ISSN: 2320-2602.
- [13] Kaur S, Singh I. Comparison between Edge Detection Techniques. International Journal of Computer Applications. 2016; Vol. 145-No. 15, ISSN: 0975-8887.
- [14] P. Elayaraja, M. Suganthi. Survey on Medical Image Segmentation Algorithms. International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE). 2014; Vol. 3, Issue. 11, ISSN (ONLINE): 2278-1021.
- [15] Reddy D. N, Mohan A. R, Bhat S. Canny Edge Detection using Verilog. International Journal of Engineering Science & Research Technology (IJESR). 2014, 3(6), ISSN: 2277-9655.
- [16] Shokhan M. H. An Efficient Approach for Improving Canny Edge Detection Algorithm. International Journal of Advances in Engineering & Technology (IJAET). 2014, ISSN: 22311963.
- [17] Nigam R. K, Waghmare N. P, Gupta A. K. Evaluation and Analysis of Different type of Edge Detection Techniques on Cartridge Case Image. International Journal on Recent and Innovation Trends in Computing and Communication. 2014, Vol. 2, Issue: 10, ISSN: 2321-8169.
- [18] Y. Ramadevi, T. Sridevi, B. Poornima, B. Kalyani. Segmentation and Object Recognition using Edge Detection Techniques. International Journal of Computer Science & Information Technology (IJCSIT). 2010, Vol. 2, No. 6, DOI: 10.5121/ijcsit.2010.2614.