NEW HORIZON
COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade.

"EDGE DETECTION FOR IMAGE SEGMENTATION IN IMAGE PROCESSING"

A MINIPROJECT REPORT

Submitted by

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

Certified that the mini project work entitled "**Edge Detection for Image Segmentation in Image Processing**" carried out by **Nidhishree K (1NH18EC078), Anusha R (1NH18EC089), Yoshitha (1NH18EC126), Uma Devi (1NH18EC114)** bonafide student of Electronics and Communication Department , New Horizon College of Engineering, Bangalore.

The mini project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the said degree.

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ACKNOWLEDGEMENT

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ABSTRACT

Edge detection for Image Segmentation in Image Processing

In today's Digital World, there are many digital applications that help us take pictures and videos of beautiful nature, but these images are not always clear. There is always certain noise in it, which needs to be treated so we can get a clear image. Noise is always present in digital images during acquisition of these images, coding or transmission, and processing steps.

Image edge detection is an integral component used to enhance the clarity of edges and also its type.

Digital image processing is a computer operated process that is widely used today for editing pictures or to manipulate the pictures. One form of image processing is edge detection. Images taken on camera or any other imaging system, it might be distorted due to variation in intensity, illumination or contrast. All these can be collectively grouped as noise.

It's tedious to remove these noises from those images without proper knowledge of filtering techniques. The filtering technique used here is a Median Filter.

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. Hence it is a vital step in image analysis. It is used for feature extraction and object segmentation. Edge detection methods transform original images to edge images from the changes of gray tones in the image.

There are many types of Edge Detection Techniques. Namely Sobel edge detection, Canny edge detection, Prewitt edge detection, Roberts Edge detection, Fuzzy logic edge detection. Two edge detection algorithms namely Canny edge detection and Sobel edge detection algorithms are used here.

Performance factors are analyzed namely accuracy and speed to figure out which algorithm executes it better.

The main purpose of edge detection is to simplify the image data in order to minimize the amount of data to be processed. Image processing works by detecting discontinuities in brightness and used for image segmentation and also for data extraction in areas in image processing.

Image processing has applications in different fields such as medicines, astronomy, product quality, in industrial applications and also it plays an important role in segmentation and object identification process.

CHAPTER 01

INTRODUCTION

Edge detection is the process of identifying points in a digital image at which the brightness of the image changes. Edge detection includes mathematical methods. Image detection is one of the significant part of image processing. It helps in image morphing, image segmentation, image extraction. The edge is one of the information contributors to any image, hence the edge detection is a very significant step in many of the image processing algorithms. It represents the outline of the image which is helpful to recognize the image as an object with its edges that are detected.

The property of the edge detection is the detection of the edges also with the good orientation of the object in the image. The edges are basically classified into four types in any kind of image. Namely , step edge, ramp edge, roof edge and line edge.

Image information is the main target for image processing and it is more popular from the past 30 years. Canny edge detector is a standard edge detection algorithm among the present edge detection algorithms. An image consists of different types of information such as the size, color, orientation of different things present in that image.

Image segmentation is also an important application of digital image processing. Image segmentation is only another step of image processing. Accuracy of segmentation determines the success or failure of computerized analysis of procedures. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision.

Image processing includes a variety of methods for identifying the points in digital image where the image brightness changes sharply and the points where the image brightness changes sharply are organized into a set of curved line segments terms as edges .

In ideal cases, the result of applying an edge detector to the image may lead to a set of connected curves that indicate boundaries of the objects by applying an edge detector to an image may reduce the amount of data to be processed and filter out important information and the contents in the original image .

Edge detection is one of the fundamental steps in image processing where the image analyses, image recognition and computer vision techniques, if the edge detection step is successful then the subsequent task of collecting information contents of the original image will be simplified.

CHAPTER 02

LITERATURE SURVEY

Comparison of Edge Detection Technique in Image Processing Techniques

By,

Ireyuwa. E. Igbinosa
University of KwaZulu-Natal,
South Africa
2013

Published in 2013

INTRODUCTION

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity scene. Traditional method of edge detection involves convolving the image with an operator (2-D filter) which is constructed to be sensitive to large gradients. Edge detectors form a collection of very important local image processing methods to locate sharp changes in the intensity function. Edge detection is an important technique in many image processing applications such as object recognition, motion analysis, pattern recognition, medical image processing etc. This paper shows the comparison of edge detection techniques under different conditions showing advantages and disadvantages of the selected algorithms. This was done under Matlab. Further work would be to develop a novel algorithm using the working on the disadvantages and advantages of the existing one to create a novel edge detector.

Image used for Detection Analysis

Fig 2.1

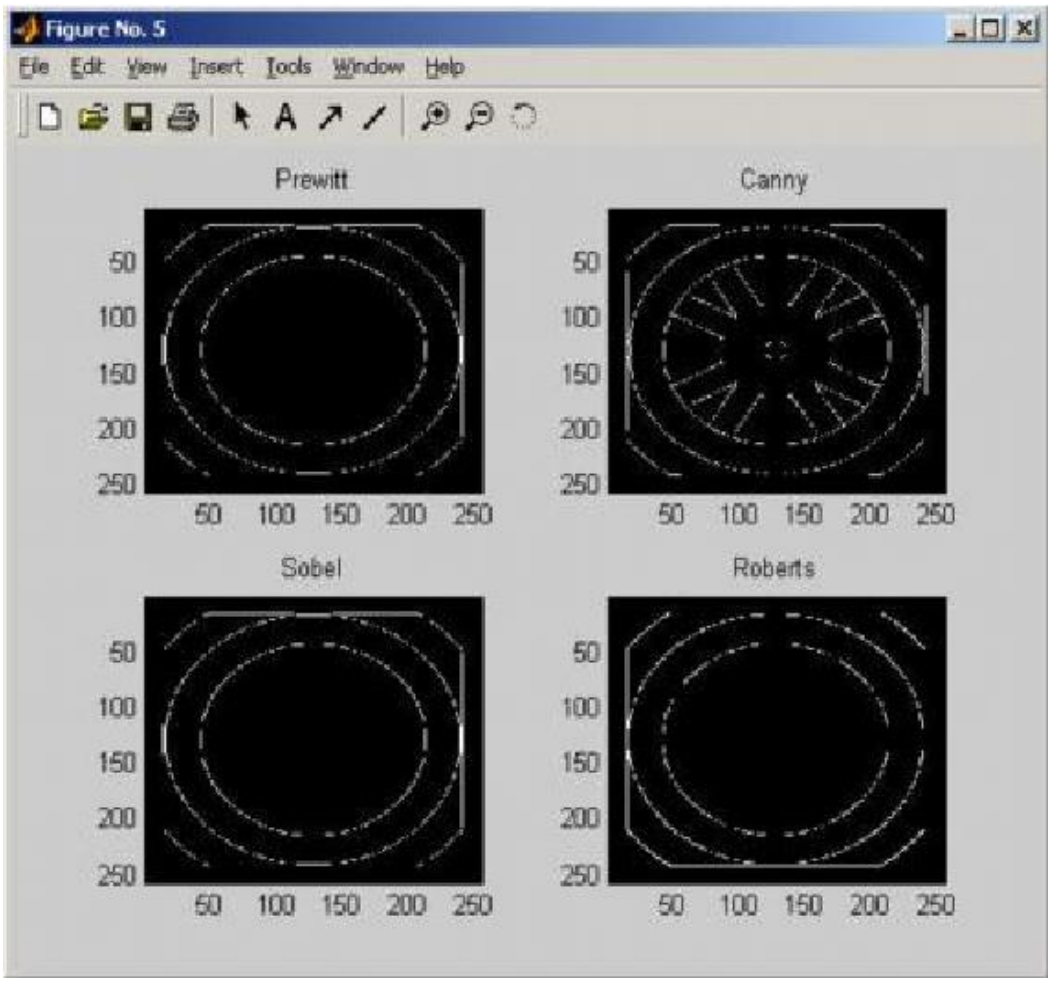


Fig 2.2

CONCLUSION

Different types of edge detection techniques were performed on the input image namely, Prewitt edge technique, Canny edge technique,Sobel edge technique and Robert edge technique.

From edge detection performed , Canny yielded the best result. This was expected as Canny uses probability for finding error rate and localization. By using non-maximal suppression ,canny yields thin lines for its edges. It also utilizes hysteresis with thresholding hence it produces better detection.

Canny edge detection algorithm

BY,

AMRUTA L KABADE

II.Year, M.Tech,

DSCE,

Bangalore.

Published in May,2016

Introduction

In this chapter the requirement of edge detection and its application and also introduction to the types of edge detection algorithm is mentioned. Edge detection is one of the significant sections of the image processing algorithms which have many applications like image morphing, pattern recognition, image segmentation and image extraction etc. As the edge is one of the major information contributors to any image, hence the edge detection is a very important step in many of the image processing algorithms. It represents the contour of the image which could be helpful to recognize the image as an object with its detected edges. In the ideal case, by applying the edge detector to an image gives the different edges that are connected to form the outline of the object. Important property of edge detection is the detection of the exact edges along with the good orientation of the object in the image. And the memory required to store the edges of an image is less compared to the whole image even though it contains all information of the shape and orientation of the object.

Edge is portrayed from various perspectives as the inventors differentiate, one of them is "It is changed either in the brightness or the colour of an image ". It is discovered that edges are basically depicted into four sorts in any image. They are step edge, ramp edge, roof edge and line edge. Many edge detection algorithms are proposed by many researchers and they are mainly classified into two types based on the order of derivative used

1.Gradient Based

2.Laplacian Based

Canny edge detector is a standard edge detection algorithm for many years among the present edge detection algorithms. Image information is the main target for image processing and it is more popular from the past 30 years.

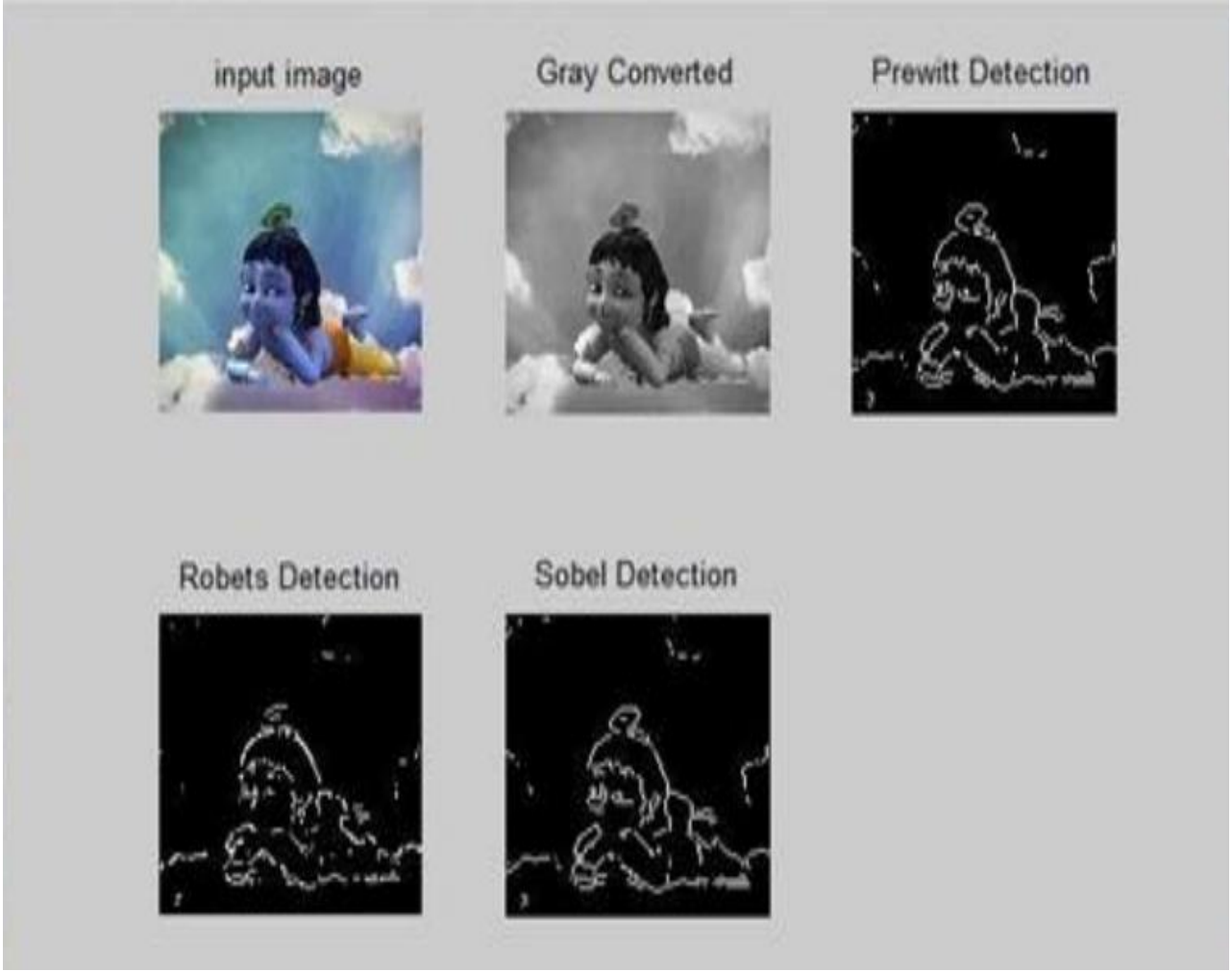


Fig 2.3

CONCLUSION

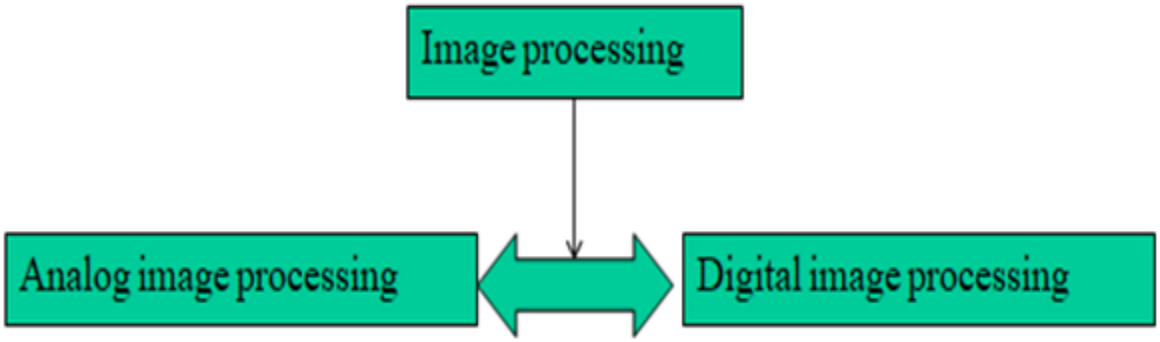
To get a better edge map the canny edge detector is applied to each block of an image but it leads to the detection of false edges in the smooth region and fails to detect some of the true edges. In order to defeat this, a block level canny edge detector is proposed which could give better performance at each block of the image.

Canny edge detector is a standard edge detection algorithm for many years among the present edge detection algorithms. Image information is the main target for image processing and it is more popular from the many years in medical image processing.

CHAPTER 03

EXISTING SYSTEM AND PROBLEM STATEMENT

Existing systems:



●**Analog image processing** can be used for hard copies like printouts and photographs.

●**Digital image processing** techniques help in manipulation of the digital images by using computers.

The three general phases that all types of data have to undergo while using digital techniques are preprocessing, enhancement, display, information extraction.

Problem Statement:

Image used for detecting the edges contains lot of noise, which should be filtered

Objectives:

- To get a clear image without any noise.
- Compare between sobel and canny edge operator.
- Finding out which is the best suitable edge operator.

CHAPTER 04

PROPOSED METHODOLOGY

The edge representation of an image remarkably reduces the quantity of data to be processed, yet it preserves crucial information regarding the shapes of the objects in a picture. This explanation of an image is easy to incorporate into a large number of object recognition algorithms used in computer vision along with other image processing applications. The prime feature of the edge detection technique is its ability to extract the precise edge line with good orientation.

Edge detection is a primitive tool for image segmentation. Edge detection methods modify original images into edge images. In image processing, especially computer view, edge detection treats the localization of important variations of gray scale image and the detection of physical and geometrical properties of the objects in scene.

It is an elementary process that detects outlines and boundaries of an object and the background in an image. Edge detection is the most prominent approach for detecting significant discontinuities in intensity values.

Edges are local changes in the image intensity. Edges regularly occur on the boundary between two regions. The main properties can be extracted from the edges of the image. Edge detection has significant features for image analysis. These features are used by advanced computer vision algorithms.

Edge detection can also be used for object detection which in turn serve for various applications in the medical field for image processing, biometrics etc. Edge detection is an active area of research as it facilitates higher level image analysis. There are three various types of discontinuities in the gray scale level like point, line and edges. Spatial masks can be used to detect all these three types of discontinuities in an image.

There are several edge detection techniques for image segmentation. The most prominently used discontinuity based edge detection techniques are Roberts edge detection, Prewitt edge detection, Kirsch edge detection, Robinson edge detection, Marr-Hildreth edge detection, LoG edge detection, Sobel edge detection and canny edge detection. The latter two have been used in the project.

CHAPTER 05

SOFTWARE SPECIFICATION

For our project,

SOFTWARE USED : Matlab

SOFTWARE VERSION : Matlab 16.0

DEVELOPER : Mathworks

DESIGNED BY : Cleve Barry Moler

Fig 5.1

MATLAB, commonly said to be a matrix laboratory, is a high performance language for technical computing .
Developed by Mathworks which is a American Company.

This allows

- Matrix calculations and operations
- implementation of algorithms
- plotting of data and functions
- interfacing with programs with other computer languages.

Although it is considered primarily for numerical computing.

Simulink, adds graphical multi-domain simulation and model-based style for dynamic and embedded systems.

Advantages,

- We can call external libraries.
- Debugging is easy
- Development of computational code is easy

Disadvantages,

- The cost of original license for MATLAB software is very high , therefore unaffordable by man

CHAPTER 06

PROJECT DESCRIPTION

6.1 EDGE DETECTION ALGORITHM

Edge Detection Algorithm, in our project is done by two operations, namely Sobel edge operator and Canny edge operator .

These operators are used to detect the edge pixels of a given image.

6.2 SOBEL EDGE OPERATOR

It is the first derivative operator. The Sobel operator is used in image processing, peculiarly within the edge detection algorithms. Technically, it's a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each point within the image, the results of the Sobel operator are either the corresponding gradient vector or the norm of this vector. The Sobel operator is expected to convolve the image with an integer valued filter in horizontal and vertical direction. On the opposite hand, the gradient approximation that it produces is comparatively crude, especially for top frequency variations within the image.

$$Gx = \begin{pmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{pmatrix} \qquad Gy = \begin{pmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{pmatrix}$$

Mathematical Operation of Sobel Filter

Mathematically, the sobel filter uses two 3*3 kernels that is convolved with the source image A to calculate the approximations of the derivatives. One changes for the horizontal and other for the vertical. A defined as the given source image, Gx and Gy are two images which in each point contain the horizontal and vertical derivative approximations. The calculations are as follows,

$$Gx = \begin{pmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{pmatrix} *A \qquad Gy = \begin{pmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{pmatrix} *A$$

Where, * denotes the two dimensional convolution operation.

Because the products of an averaging and a differentiation kernel, the sobel kernels are often decomposed. They compute the gradient with smoothing. For example, can be written as

$$\begin{pmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix} \begin{pmatrix} -1 & 0 & 1 \end{pmatrix}$$

The x-coordinate is defined as increasing within the right direction, and therefore the y-coordinate is defined as increasing within the down direction. At each point within the image, the resulting gradient approximations are often combined to offer the gradient magnitude, using:

$$G = \sqrt{Gx^2 + Gy^2}$$

Using the following information, we will calculate the gradient's direction:

$$\Theta = \arctan\left(\frac{Gy}{Gx}\right)$$

where, for example, Θ is 0 for a vertical edge which is darker on the right side.

BLOCK DIAGRAM OF SOBEL EDGE DETECTION

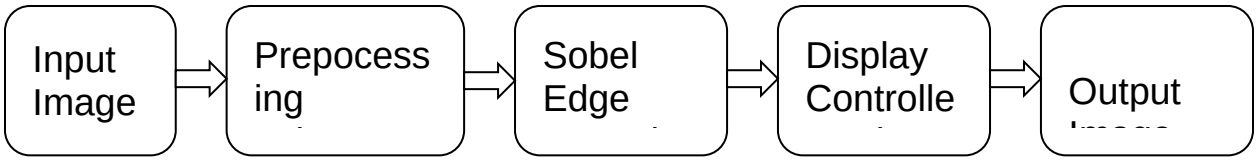


Fig 6.1

ADVANTAGES

- Its non-directional and it finds edges in all the directions
- It gives magnitude i.e brightness value in all the directions.
- It is the product of averaging and different kernel ,hence computes the gradient after smoothing the noise in the given input image
- It easily computes and gives better results.

TECHNOLOGY USED

- Data used in satellite imaging of PAN poanta.
- Programming languages such as Java, Core Java
- Packages in GDAL.

EXAMPLES:

Fig 6.2

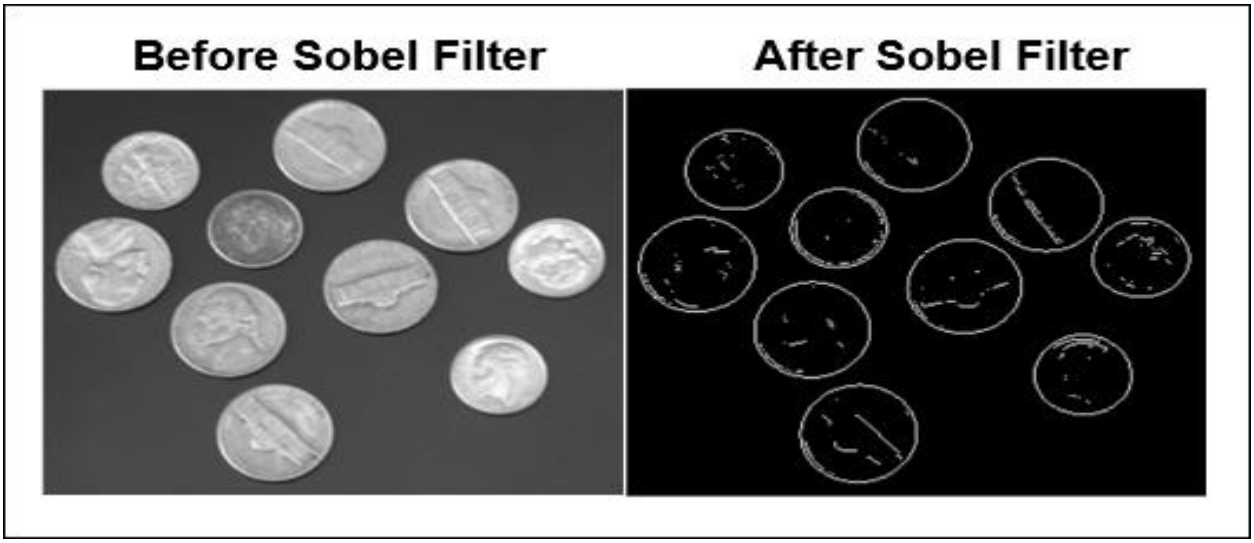


Fig 6.3

6.3 CANNY EDGE OPERATOR

Canny edge operator is an edge operator that consists of a multi stage algorithm to detect edge pixels of a given input image which consists of a wide variety or range of noises. . It is the best edge detection technique because it provides best detection, clear response and better localization. First the image is to be filtered(pre-processing techniques like smoothing, median filtering ,Gaussian filtering). Best filter used for removing noise in canny edge detection is Gaussian Blur filter.

$$Gx=\begin{pmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{pmatrix} \qquad Gy=\begin{pmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{pmatrix}$$

Mathematical Operation of Canny edge operator

STEP 1: Noise reduction by pre processing technique called smoothing

Noise in the given input image is smoothed by convolving the input image A with Gaussian filter. Mathematically, the resultant image is given by,

STEP 2: Obtain the gradiants.

In this step detect the edges where the change in grayscale intensity is maximum. Required areas are determined with the assistance of gradient of images. Sobel operator is used to determine the gradient at each pixel of a smoothened image. Operators given in i and j axis directions is given as,

$$Gx=\begin{pmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{pmatrix} \qquad Gy=\begin{pmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{pmatrix}$$

These sobel masks are convolved with a smoothed image and giving gradients in i and j directions.

$$Di=Gi*\ F(i.j) \qquad \text{and} \qquad Dj=Gj*\ F(i.j)$$

Therefore, magnitude of the gradient of a pixel ,

$$G=\sqrt{Gi^2 + Gj^2}$$

The direction of gradient is given by,

$$\Theta = \arctan\left(\frac{Gj}{Gi}\right)$$

Gi And Gj are among the gradients within the i- and j-directions respectively.

STEP 3: Application of non-maximum suppression to get rid of false response

Non-maximas are made as zero that is suppression the non- maximas, thus the step is called Non-Maximal Suppression

Step 4: Double threshold is applied to determine the potential edges.

The high and low thresholds are measured using the histogram

BLOCK DIAGRAM OF CANNY EDGE DETECTOR

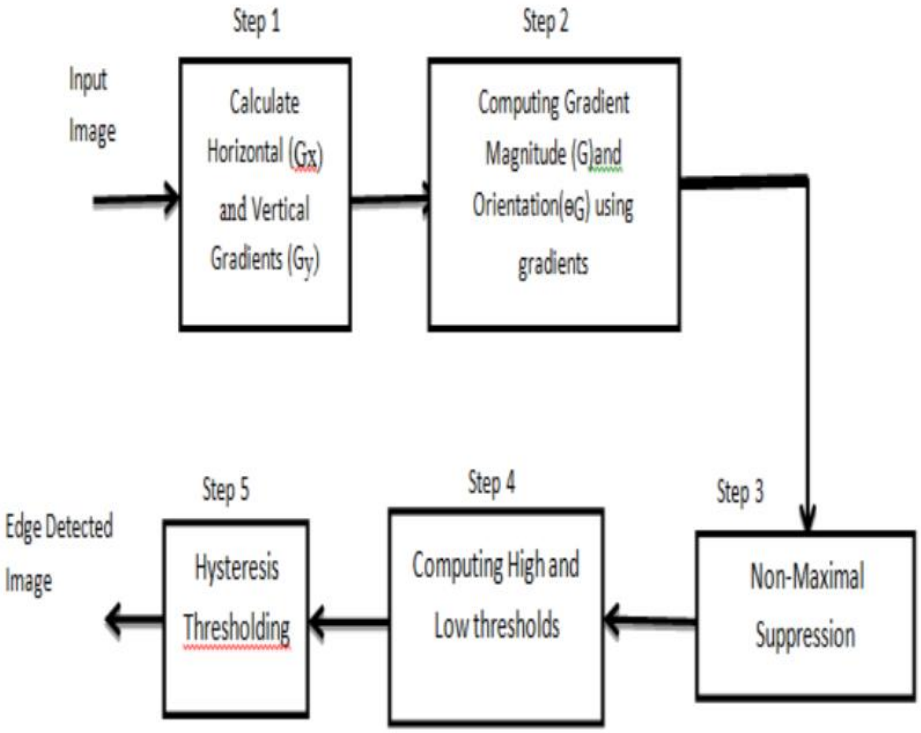


Fig 6.4

ADVANTAGES

- It is less sensitive to noise.
- It removes streaking problems.
- Adaptive in nature.
- Good localization.

DISADVANTAGES

- Lot of time due to its complex computations..
- It is difficult to implement to reach the real-time response.

APPLICATIONS

- Medical Diagnosis
- License Plate detection
- Face Recognition

EXAMPLES:

Original Image **Canny Edge Detected Image**

Fig 6.5

6.4 BLOCK DIAGRAM OF OUR PROJECT

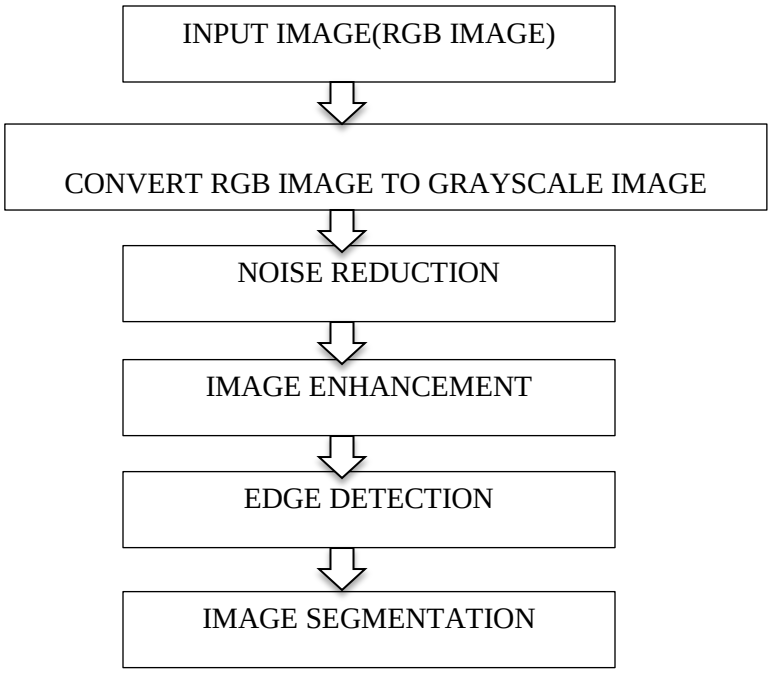


Fig 6.6

Syntax used,

SYNTAX	FUNCTION
imread( )	read an image from specific location
imresize( )	geometric transformation on an image
imshow( )	display the image
rgb2gray( )	convert color image to grayscale image
imnoise(filename,noise type)	add noise to an image
imadjust( )	adjust contrast of an image
im2bw( )	converts the image to binary image
edge(filename,method)	to detect the edge of an image
imshowpair( )	displays multiple images sp as compare between the two images

Table 6.1

6.6 FLOWCHART

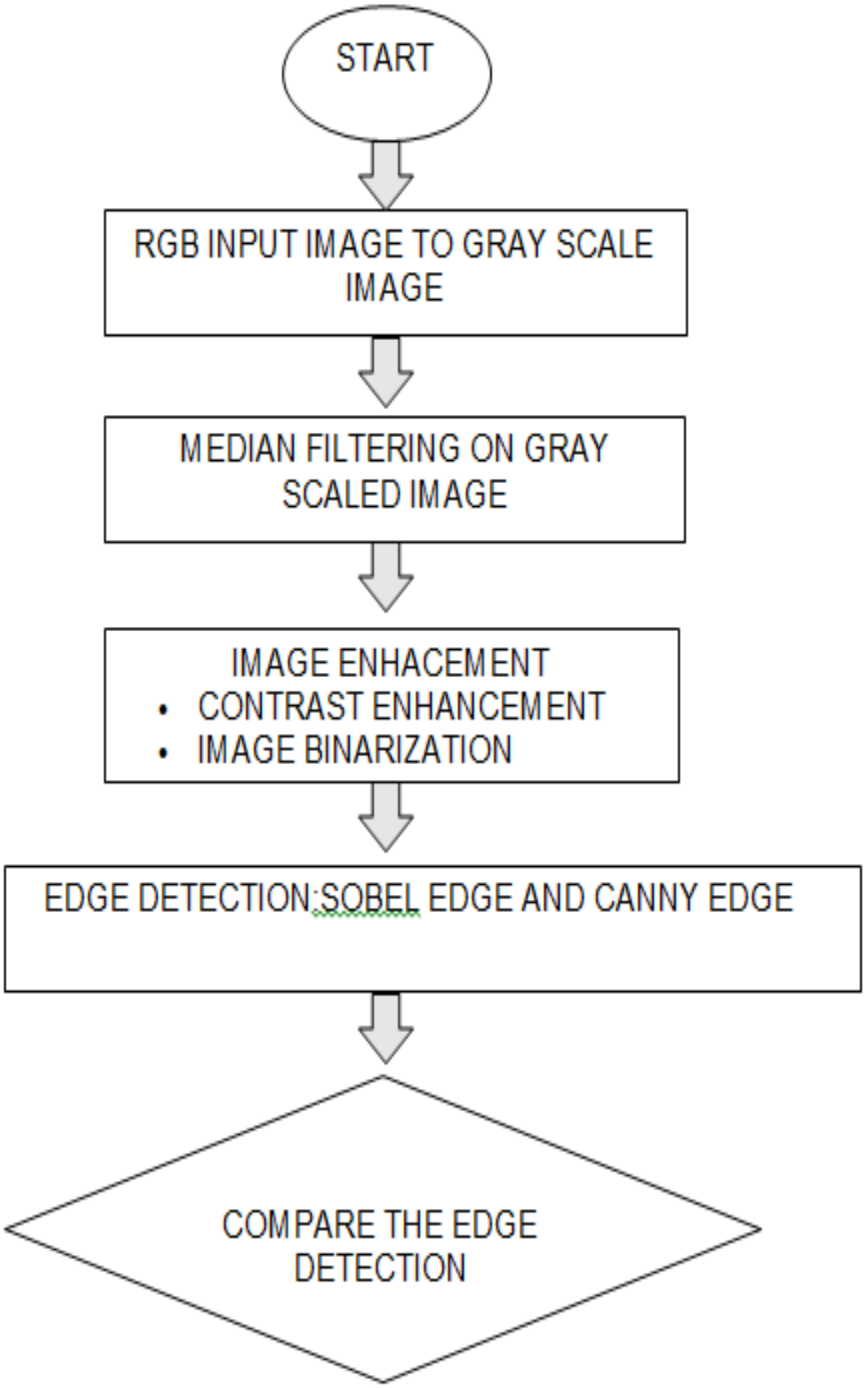


Fig 6.7

6.6 WORKING

- **STEP 1**: Read the image by giving the the appropriate location by the syntax ***imread(image location).***

Fig 6.8

PRE-PROCESSING STEPS:

- **STEP 2**: **GRAYSCALING** :Converting the RGB image to Gray-scaled image using syntax ***rgb2gray(image name).***

Fig 6.9

- **STEP 3**: Perform median filtering on the resultant image to remove noises.
  Noise removal algorithm is used. It is the process of removing the noise from the image without disturbing edges.Here noise is first added to an image and then filter is further performed.
  Type of noise added is 'SALT & PEPPER' of standard deviation 0.02.

imnoise(imagename,'salt & pepper',0.02);

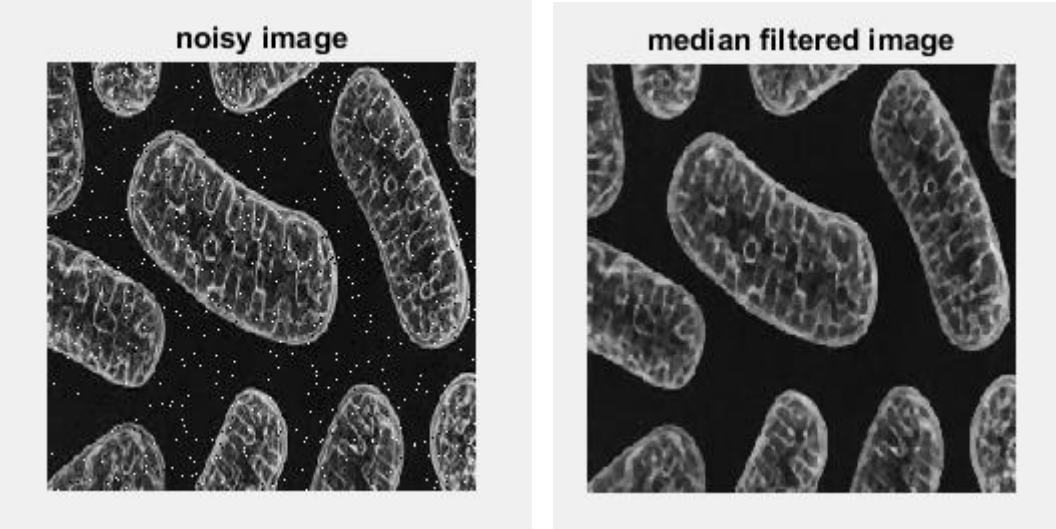


Fig 6.10

POST-PROCESSING STEPS:

- **STEP 4**: includes sharpening of image features (edges, boundaries, contrast) to improve image visual appearance and analysis using syntax,
  imadjust(imagename);

Fig 6.11

- **STEP 6**: converting the resultant image to binary image using syntax ***im2bw(imagename);***

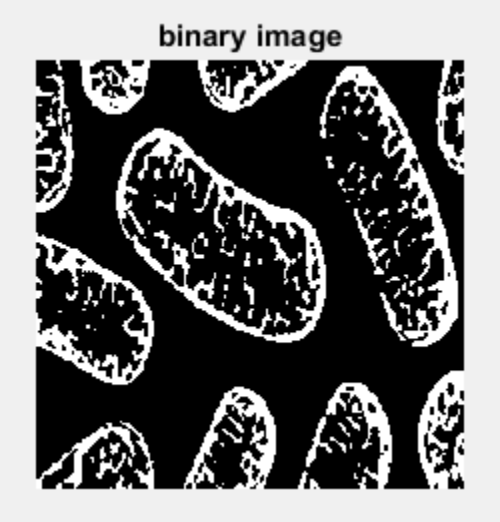


Fig 6.12

- **STEP 6**: Apply the edge function, sobel edge and canny edge to detect the edge of the image,
  O=edge(imagename,'sobel');
  P=edge(imagename,'canny');

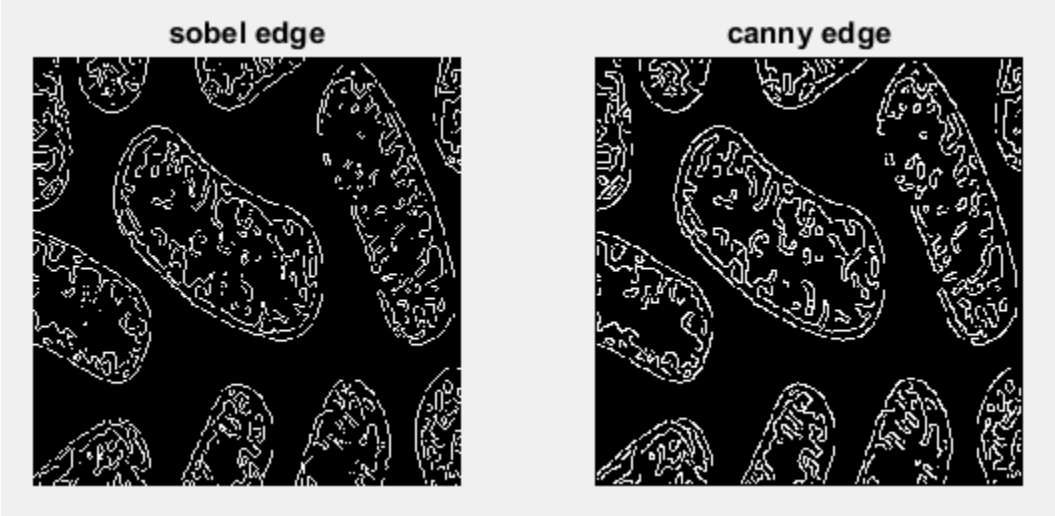


Fig 6.13

Compare the two edge functions.

CHAPTER 07

RESULT AND DISCUSSION

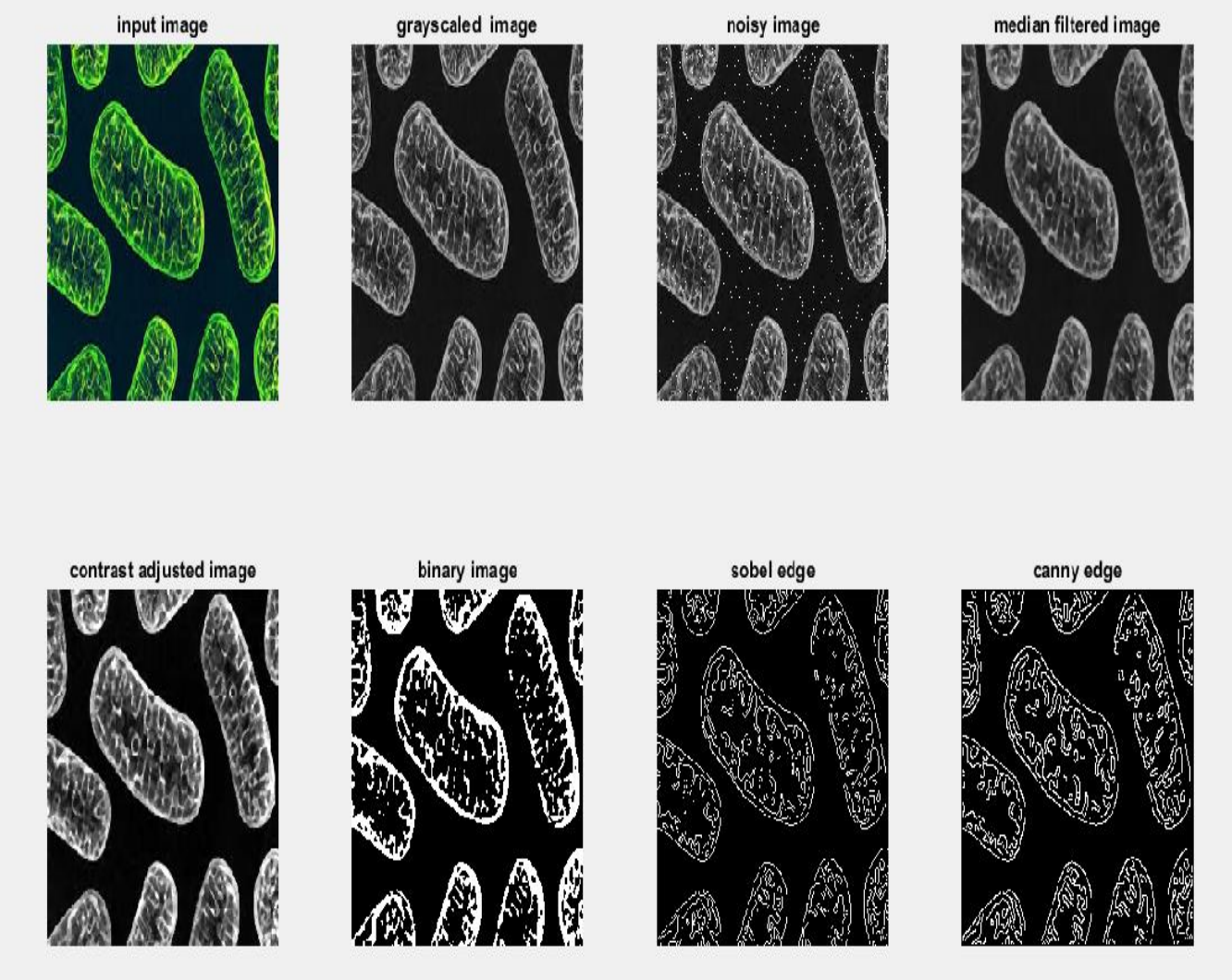


Fig 7.1

Fig 7.2

Sobel edge operator and Canny edge operator have been implemented on the input source image and shown in the above image.

We have seen that a canny edge detector gives a better result as compared to sobel edge detector shown in Fig 6.11.Canny operator provides the clear edges as compared to the sobel edge operator.

Canny edge has reduced noise as compared to that of sobel edge operator.

In the Sobel image , shown in the left side of the above image ,we have observed that the edges are too messy and most of the important structure is lost.Hence the important data is lost from them. This leads to the abnormalities in the report .

In the Canny image, shown in the right side of the above image, edges are smoothly detected with least noise protecting the important structures of the image. Smooth and clean edges are produced. Hence the clear view of the cell is obtained. Hence gives the best report.

CHAPTER 08

CONCLUSION AND FUTURE SCOPE

In our project we have studied and evaluated two different edge detection techniques. We have seen that a canny edge detector gives a better result as compared to sobel edge detector shown in Fig 6.11.

In the Sobel image , shown in the left side of the above image ,we have observed that the edges are too messy and most of the important structure is lost. Hence the important data is lost from them. This leads to the abnormalities in the report .

In the Canny image, shown in the right side of the above image, edges are smoothly detected with least noise protecting the important structures of the image. Smooth and clean edges are produced. Hence the clear view of the cell is obtained. Hence gives the best report.

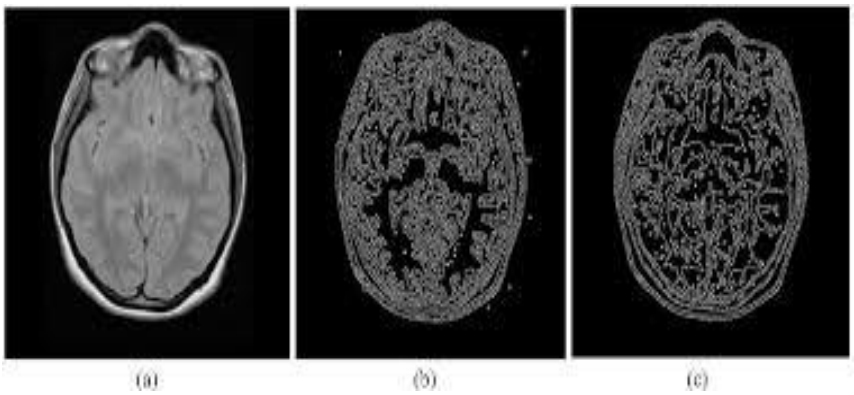
It is less sensitive to noise, adaptive in nature, resolves the matter of streaking, provides good localization and detects sharper edges as compared to others.

It is considered an optimal edge detection technique, a lot of work and improvement on this algorithm has been done .

Further improvements are possible in future as an improved canny algorithm can detect edges in color image without converting in grayscale image.

In future it can used for Detection of vehicle through license plate detection technique which is important part of traffic problem and public safety, MRI Imaging in medical image processing, Face recognition, Cable insulation layer measurement

It also finds application in the medical field as in MRI scanning, ultrasound, x –rays etc.



Brain Edge detection

Fig 8.1

CHAPTER 8

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APPENDIX

Project code: edge detection for image segmentation

```
clc;
clear all;close all;

%READ INPUT IMAGE
I=imread('E:\C\Pictures\Saved pictures\cel9.jpg');
I=imresize(I,[266 266]);
[m,n]=size(I);
subplot(2,4,1);
imshow(I);title('input image');

%GRAYSCALING
K = rgb2gray(I);
subplot(2,4,2);
imshow(uint8(K));title('grayscaled  image');

%MEDIAN FILTERING OF AN IMAGE
noisy = imnoise(K,'salt & pepper',0.02);
[m,n]=size(noisy);
M=zeros(m,n);
M=uint8(M);

for i=1:m
    for j=1:n
```

```
    xmin=max(1,i-1);
    xmax=min(m,i+1);
    ymin=max(1,j-1);
    ymax=min(n,j+1);

    temp=noisy(xmin:xmax,ymin:ymax);
    M(i,j)=median(temp(:));
    end
end

subplot(2,4,3);
imshow(uint8(noisy));title('noisy image');
subplot(2,4,4);
imshow(uint8(M));title('median filtered image');

%IMAGE ENHANCEMENT
D = imadjust(M);
subplot(2,4,6);
imshow(uint8(D));title('contrast adjusted image');

%BINARY IMAGE
E = im2bw(D);
subplot(2,4,6);
imshow(E);title('binary image');

%EDGE DETECTION
O=edge(E,'sobel');
P=edge(E,'canny');
subplot(2,4,7);
imshow(O);title('sobel edge');
```

```
subplot(2,4,8);
imshow(P);title('canny edge');
figure,
imshowpair(O,P,'montage');title('edge detection');title('SOBEL EDGE                CANNY EDGE');
```