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Review Article

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EDGE DETECTION OF MRI IMAGES –A REVIEW

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ABSTRACT

MRI, CT Scan, XRay are various methods of analyzing the area of brain. MRI images of brain can be used to gather information about the brain that helps to find anomalies in the brain, thus it shows whether the person is suffering from some disease of the brain or not. There are several categories of brain ailments. One of them is tumor development in the brain. Edge detection technique can be a useful way of finding presence of tumor in the brain. Edge detection of the image segments the brain into several parts, yet there are challenges in the method since, intensity of healthy tissue, tumor and surrounding fluids overlap.

KEY WORDS: Edge detection, Noise filters and Types of Edges.

INTRODUCTION

To analyze MRI images, following information needs to be extracted from the MRI image

1. Analysis of the MRI image depending on the intensities of the different region of the image
2. The area pertaining to the several intensities in the image
3. Edge detection of the different areas of the image.

Edge detection can be a useful technique to check for any abnormal growth in the brain area.

Generally following flow of operations can be used to check for any abnormal growths in the brain area. The following figure indicates block diagram of the basic steps for proposed method

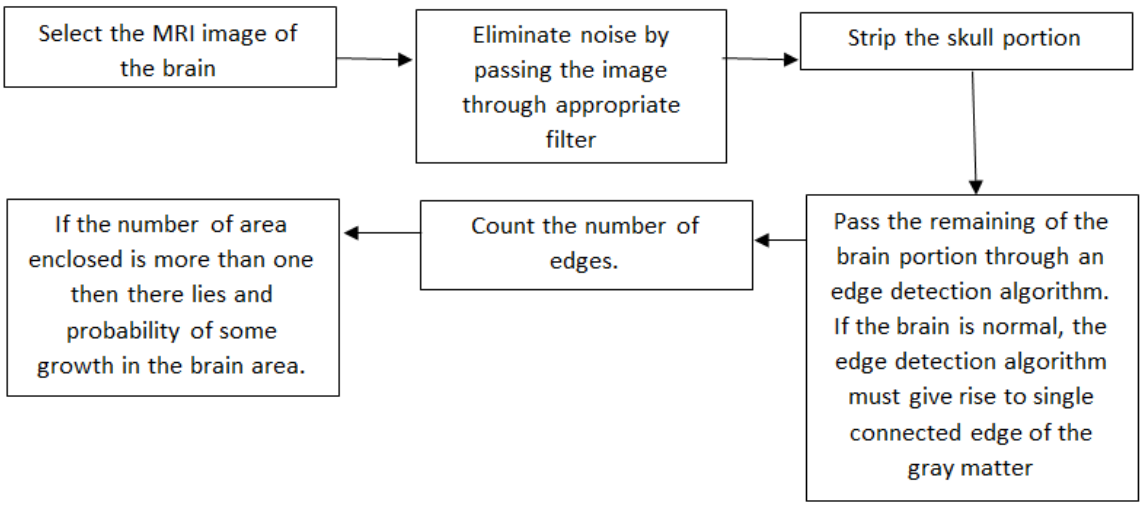


Figure 1 Basic steps for Edge Detection

There are several edge detection algorithms that are available for edge detection, but edge detection algorithms face several challenges.

The challenges of edge detection algorithms are as follows[2]

- Due to noise, sometimes fake edges are detected
- Missing to detect real edge points and detecting fake edges.
- Multiple responses to each edge in the image should be avoided.
- The changes in lighting conditions

- Background is dynamic
- Geometrical features
- Position of the detected edge to be shifted from its true location

There exists different types of edges in images shown in figure 2.[2-3]

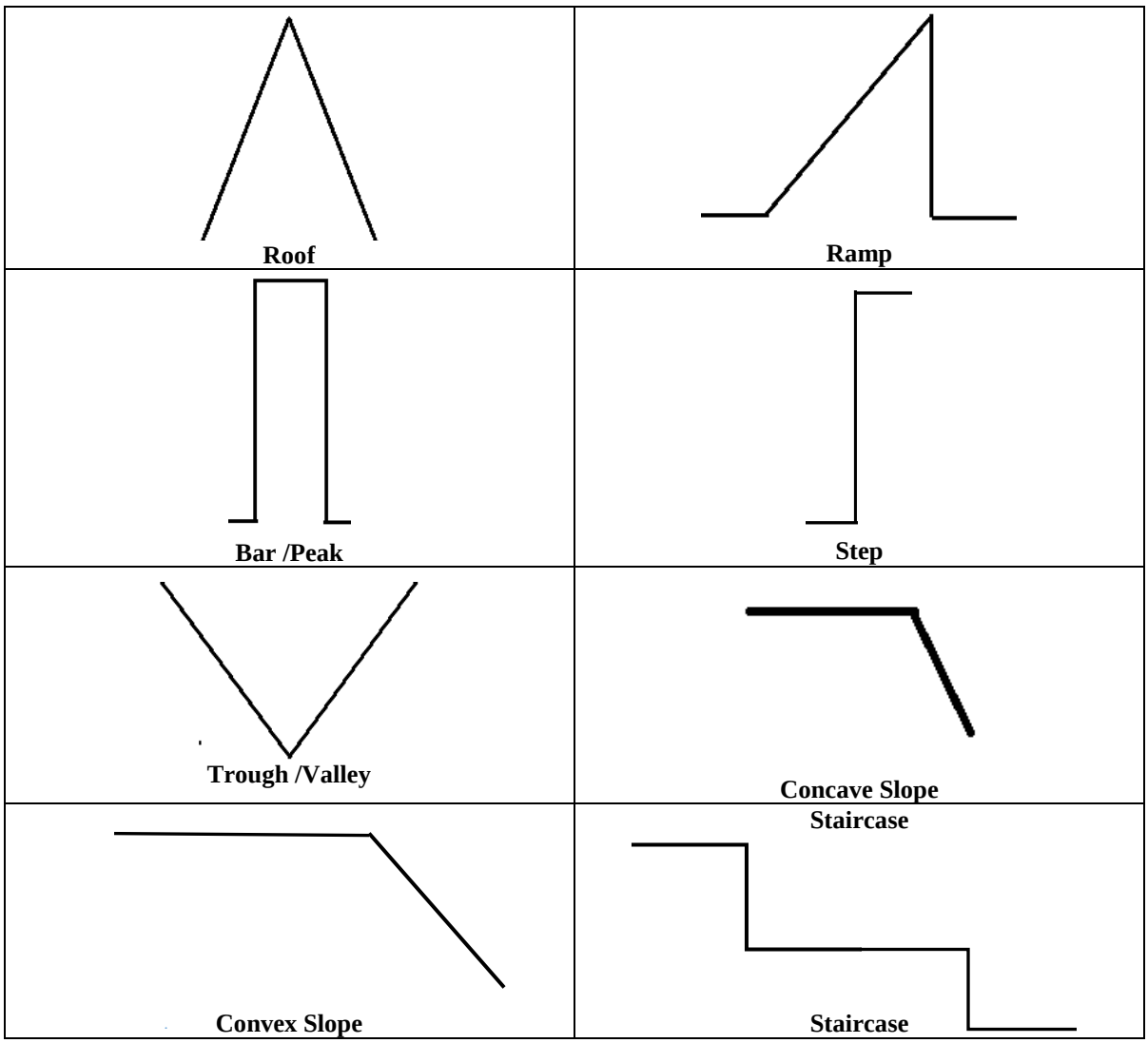


Figure 2 Different types of edges in images

Review Works

There are several edge detection methods are available. We will discuss them next.[3]

1. Gradient based method

The algorithms used in this method generally identifies horizontal and vertical edges separately and then combine the results of the detection. The algorithms in this method are very susceptible to noise.

2. Laplacian method

This method identifies edges which are like slope, ramp or rise. The derivative of the image specify the location of the edge. If the gray level intensity is varied at corners and curve region of image then it is difficult to find out edges in the image. It is also difficult to find out orientation of edge.

3. Gaussian edge detectors

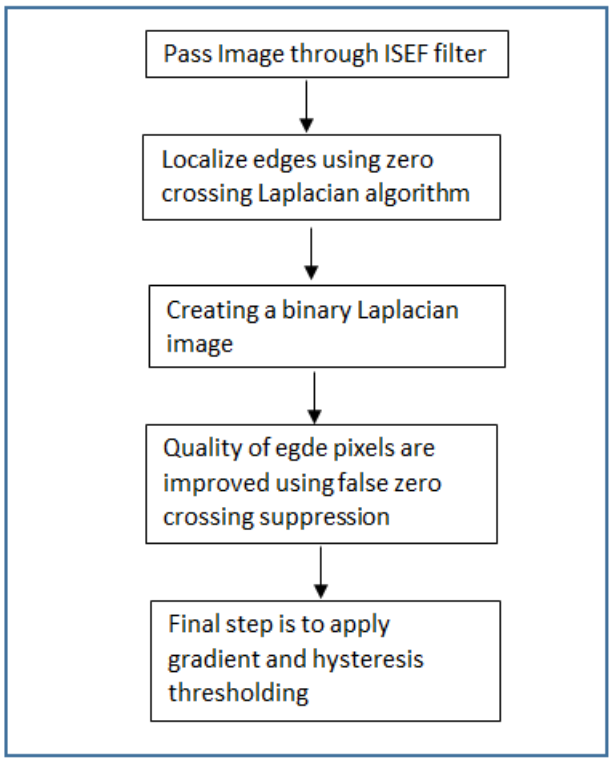
Gaussian edge detectors are more appropriate for images with noise as the first step in Gaussian edge detection algorithm is smoothening of the image. And increasing the signal to noise ratio. The Gaussian edge detector uses the Canny and Shen Casten operators.

a. Canny edge detector method

b. Shen-Castan Edge Detector[4]

Shen-Castan edge detector applies an Infinite Symmetric Exponential Filter (ISEF) filter function. This produces better signal to noise ratios and better localization than Canny. The basic flowchart is given below

Flowchart



Canny edge detector method[5, 6]

For edge detection Canny mentioned three points which are as follows[1]

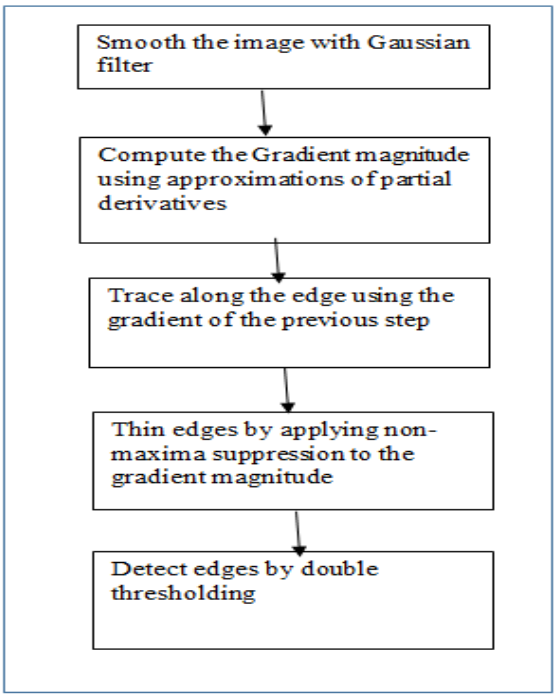
Error rate: The edge detector should respond only to edges, and should find all of them; no edges should be missed.

Localization: - The distance between the edge pixels as found by the edge detector and the actual edge should be as small as possible.

Response: The edge detector should not identify multiple edge pixels where only a single edge exists**.**

The basic flowchart is shown below

Flowchart



The first step in the canny edge detector algorithm, the noise is handled using Gaussian blur filter. The next step uses Sobel masks to find the edge gradient strength and direction of each pixel. The next step involves tracing along the edges based on the gradient strengths and edge directions calculated previously. One of the challenges of canny edge detection algorithm is to select the thresholds. If lower threshold is too low, then false edges will remain, whereas if the upper threshold is too high then some true edges will disappear.

Image of a Brain with tumor

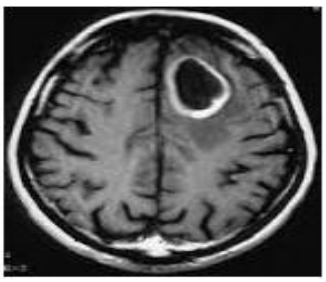


Figure 3

Image of Tumor brain after passing through Canny edge detector algorithm

Figure 4

Image of the brain with tumor after passing through Canny edge detector where lower threshold is 0.2 and higher threshold is 2.5. As seen in the image below, the lower threshold of 0.2 gives rise to some false edges.

Image of the brain with tumor after passing through Canny edge detector algorithm

Figure 5

Image of the Tumor Brain after passing through Canny edge detector where lower threshold is 1 and higher threshold is 2.5. As seen in the image below, the lower threshold of 1 eliminates some true edges.

Salt and Pepper noise is also known as impulse noise. This noise is effect of some sharp disturbance in the signal. This noise can also be caused when the images are transferred from one media to another. This noise gives a blurred effect to the image.[7, 8]

Image of the brain with tumor with salt and pepper noise added

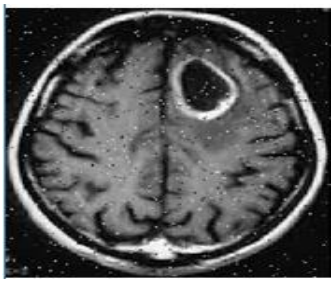


Figure 6

Image of the brain with tumor with salt and pepper noise added after passing through Canny edge detector algorithm

Figure 7

Image of the brain with tumor with salt and pepper noise after passing through Canny edge detector where lower threshold is 0.5 and higher threshold is 2.5. As seen in the image above, the Gaussian filter used in Canny detector algorithm is not enough to handle the salt and pepper noise, as a result the edge detector algorithm has given rise to lot of false edges with the lower threshold of 0.5.

Image of the brain with tumor with salt and pepper noise added after passing through median filter

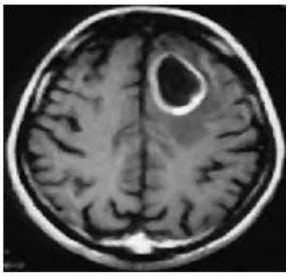


Figure 8

To handle the salt and pepper noise in Figure 8, the image is passed through median filter. The median filter

as seen in the above figure, eliminates the salt and pepper noise.

Image of the brain with tumor after passing through Canny edge detector algorithm

Figure 9

In the above figure we see that if the skull portion of the original image is ignored, the rest of the figure is divided into two are. One of the area encloses the gray matter and the other enclosed area encompasses the tumor. If the number of enclosed area can be counted, then it can be conclusive that the brain has a portion that does not belong to the gray area of the brain, thus can be treated as a medical situation.

CONCLUSION

Canny Edge Detection algorithm can be used to detect abnormal area within the gray matter area in a brain, but the lower threshold and the upper threshold has to be determined cautiously to get more accurate result. The figures above also shows that the filter used in Canny edge detection algorithm is not enough to handle salt and pepper noise. Thus brain images with such disturbances has to be passed through some additional filter to eliminate the noise.

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