### ANALYSIS OF SOBEL EDGE DETECTION AND CANNY EDGE DETECTION FOR FEATURE EXTRACTION IN MEDICAL IMAGE RETRIEVAL

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KEYWORDS: Content Based Image Retrieval, Feature Extraction, MRI, Canny, Sobel.

### ABSTRACT

Content based image retrieval system plays an important role in performing diagnostic image analysis. Edge detection is a basic tool used in image processing, fundamentally for feature detection and extraction, which aims to discover points in a digital image where brightness of image changes sharply and finds discontinuities. Edge detection methods transform original images into edge images remuneration from the changes of grey tones in the image. The purpose of edge detection is in reducing the amount of data in an image and in conserving the structural properties for advance image processing. In this research paper, we discuss how two edge detection algorithms - that is Canny edge detection and Sobel edge detection algorithms are used to extract edges from MRI images. Performance factors are analyzed namely correctness and speed that help us to locate which algorithm works better.

### INTRODUCTION

**Content-based image retrieval (CBIR)** is also known as **query by image content (QBIC)** and **content-based visual information retrieval (CBVIR)**. It is the application of computer vision techniques to the image retrieval problem which is related to the problem of searching for digital images in large databases [12]. Content-based image retrieval is opposed to traditional concept-based approaches.

MRI can produce equally goods tissue slices in any orientation and super three-dimensional images compared to other medical images [1]. MRI image can produce the best view of tissues in any part of human body, so the analysis of MRI images plays crucial role in medical field. The filters are used in the process of identifying the images by locating the sharp edges which are discontinuous. Detection of edge is a fundamental step for most computer vision applications such as MRI feature extraction and remote sensing



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Edge detection refers to the extraction of the edges in a digital image and the process of identifying and locating sharp discontinuities in an image [9]. Edges in images are areas with strong intensity contrasts. Edge detection is an important pre-processing step for any image processing application, object recognition and object detection [6]. There are many methods to perform edge detection such as Sobel Method, Prewiit Method and Canny method.

In this paper, a comparison between Sobel and Canny edge detection method of MRI image of brain is done. Edge detection algorithm is most commonly used. Sobel Operators are the computation of the partial derivation. Canny's edge detector is one of the most popular edge detection algorithms and it is one of the most commonly used image processing tools, detecting edges in a very dynamic manner.

### **Feature Extraction**

Feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative, non-redundant, facilitating the subsequent learning and generalization steps. It leads to better human interpretations. Feature extraction is related to dimensionality reduction .

### Color

Color is one of the visual attributes that can provide more information about the visual content of an image and the most widely used feature in CBIR [7]. The color histogram is easy to compute and effective in characterizing both the global and local distribution of colors in an image. Each color in the color space is a single point represented in a coordinate system.

### Texture

Texture is important in defining features of an image [4]. Texture determination is ideally suited for medical image retrievals Systems. Purpose of texture analysis is

- 1. To identify different textured and non-texture regions in an image.
- 2. To classify different texture regions in an image.
- 3. To extract boundaries between major texture regions.
- 4. To describe the Texel unit.

### Shape

A shape is the form of an object or its external boundary, outline, or external surface, as opposed to other properties such as color, texture, material composition [4]. Shape representations techniques used in similarity retrieval are generally characterized as being region based and boundary based [7].

### **Sobel Edge Detection**

Sobel method is useful to perform edge detection. The Sobel operative performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial occurrence that correspond to edges [1]. The operator consists of a couple of 3×3 convolution kernels as shown in Fig.2. One kernel is basically the other rotated by 90°.



These masks are each convolved with the reflection. It calculates horizontal and vertical gradient (Gx and Gy), then shared together to find the absolute magnitude of the gradient at each point and the direction of that gradient. These numbers are used to compute the edge amount which given by:

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### $|\mathbf{G}| = \sqrt{\mathbf{G}\mathbf{x}\mathbf{2} + \mathbf{G}\mathbf{y}\mathbf{2}}$

The Sobel operator is a standard first order edge detection operator, computing an approximation of the gradient of the image intensity purpose. Any approximation used for first derived must satisfy the following state of affairs:

- 1. It must be zero in the area of stable intensity.
- 2. It must be nonzero at the beginning of intensity step or ramp.
- 3. It must be nonzero at points along a concentration ramp.



Figure 2. Block diagram for Sobel edge detection

**Raman Maini et al., [1]** author discussed, that Sobel edge detection method cannot produce smooth and thin edge compared to canny method of Medical images(CT Scan & MRI Scan).

Harpreet Kaur et al., [6] author discussed, that Sobel edge difficulty kernels are considered to respond to edges vertically and horizontally.

**Mohammed Rafiq Abdul Kadir et al.,[3]** author discussed, that Sobel algorithms work using a mathematical procedure called convolution and commonly analyze derivatives or second derivatives of the digital numbers over space.

### **Canny Edge Detection**

The Canny edge detector is based on computing the squared gradient magnitude [1]. Local maxima of the gradient extent that are more than some threshold are then recognized as edges. The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect an extensive range of edges in images Canny's aim was to realize the optimal edge detection algorithm [2].

In this situation, an "optimal" edge detector means:

□ **Good detection** – the algorithm should mark as many real edges in the image as probable.

□ Good localization – edges marked should be as close as possible to the edge in the actual image.

□ **Minimal response** – a given edge in the image should only be marked once, and where possible, image sound should not create copied edges.



Figure 3. Block diagram for Canny's edge detection

Raman Maini et al., [1] author discussed, that Canny method can produce equally good edge with the smooth continuous pixels and thin edge.

Harpreet Kaur et al., [6] author discussed, that Canny method can produce good edge with the smooth pixels. Canny methods also very sensitive to the noise pixels.

Mohammed Rafiq Abdul Kadir et al., [3] author tested the proposed method on different images. The implemented Canny edge detector presented the best performance both visually and quantitatively based on the measures such as mean square distance, error edge map and signal to sound ratio.

Then use the twice threshold algorithm to detect and link edges. The equation under used:

$$\mathbf{G}(\mathbf{x},\mathbf{y}) = \frac{1}{2\pi\sigma^2} \mathbf{e} \cdot \frac{x^2 + y^2}{2\sigma^2}$$

Where x is the distance from the derivation in the horizontal axis, y is the distance from the derivation in the vertical axis, and  $\sigma$  is the extend of the Gaussian and controls the degree of smoothing.

### Result

One segment of MRI sample images is implemented in this proposed methodology. Sobel and Canny edge detection operators have been implemented on that image and we can see the results. Here the input image is brain image and the gradient designed image in x and y direction is also shown. Using the Sobel method, the result shows from the image experienced, the edges detected are too confused and the data almost missing the important structure.

For Canny edge detection, using  $\sigma$  equal to 4, we set threshold value ( $\alpha$ ) equal to 0.25. At this value, the edge is smoothly detected on the image and almost no sound pixels are detected on the image, while protecting the significant structural properties in an image [7]. The best set of parameters for a particular image is not known, and so finally the user is left to judge the methods.

### **Original image**





Feature extraction for canny edge detection



Feature extraction for sobel edge detection



Comparison of Canny & Sobel edge detection



### **Image Entropy**

Image entropy is a quantity which is used to describe the 'business' of an image, i.e. the amount of information which must be coded for by a compression algorithm. Low entropy images, such as those containing and large runs of sky, have very little contrast and large runs of pixels with the same or similar DN values.

### Calculating image entropy

Image entropy as used in my compression tests is calculated with the same formula used by the Galileo imaging team:

$$Entropy = \sum_{i} p1 \text{ Log 2 Pi}$$

In the above expression, pi is the j that the difference between 2 adjacent pixel is equal to I, and Log2 is the base 2 logarithm. The entropy of an image using this expression.

### **Entropy Calculation of Canny & Sobel**

Original image	Canny	Entropy	Sobel	Entropy
		1.53804		6.50159
61	K	1.20808	E.	5.83103
0		1.43352	0	5.53122
Ň		1.58192		6.12987
ALC: NO	X	1.47781	K	5.28417

### ENTROPY GRAPHS



### Conclusion

The proposed method is compared with traditional edge detectors. The simulation results show that the technique is more efficient for medical image edge detection than traditional algorithm such as Sobel and Canny. The proposed method is decrease the computation time as possible as can with generate high quality of image edge detection. The edge detection is the primary step in identifying an image object, it is very essential to know the advantages and disadvantages of each edge detection. Also it gives smooth and thin edges without distorting the shape of images. Sometime all the noisy image cannot be filtered perfectly. Unremoved noisy pixels will effect the result of edge detection. From our analysis, we have shown that between Sobel and Canny edge detection algorithms, response given by Canny edge detection was better than result of Sobel detector used in these MRI images. An efficient technique based minimum cross entropy thresholding for detection of edges in noisy medical images.

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