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ANALYSIS OF EDGE DETECTION TECHNIQUES FOR AQUATIC IMAGES

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ABSTRACT

Image processing gains more prominence in the current scenario of assortment applications. In particular, various edge detection algorithms have been widely implemented in detecting the edges of components, particles and organisms of aquatic system images. Numerous research and study has being undergone to learn about the components of aquatic system. Since its has its wings covering many uses and applications in various areas such as., Medical field, Bio-technology, Archaeology, genetic research etc., And the utilizations over the aquatic system becomes possible by the exact identification of the internal particle. And in turn this identification becomes achievable only by the process of edge detection. Process of edge detection detects the object from the background to observe the image properly and discover the pixels of the image carefully. In this perspective, edge detection is a primary tool for image segmentation. In this paper an endeavor is made to analyze and compare the performance of frequently applied edge detection parameters for aquatic images.

KEYWORDS: Edge detection, image segmentation, Aquatic Images.

INTRODUCTION

Over 70% of the earth's surface is covered by water which contains 95% of the earth's biosphere. With 7o% of the earth’s surface covered by water, research into the chemistry is relatively unexplored and represents a vast resource for new medicines to combat major diseases such as cancer, AIDS or malaria etc. It has been a long-understood fact that the

tranquility of aquariums has been known to help relieve stress and lower heart rate and blood pressure in some. As the biomedical field continues to grow and become more important to advancements in health care, the methods and options used by research also continue to expand. For all the above mentioned research work, aquatic images serves as the first and primary source. Inorder to achieve this target, the collected aquatic images should be processed for edge detection using algorithms like roberts, sobel, prewitt and canny edge detection operators. Detecting the edges properly certainly shows the exact identification of the nature and feature of the image under water.

Image segmentation is the initial step in image analysis. Segmentation split an image into its constituent parts or objects. Discontinuity approach is to partition an image based on immediate changes in intensity and similarity is based on partitioning an image into regions that are similar according to a set of predefined criteria. Thus the process of image segmentation technique highly depends on the problem being considered. Edge detection is a part of image segmentation, which serves as a primary technique for detecting intensity discontinuities in a digital image.

In particular it has its wings specialized in feature extraction and entity or object segmentation, target tracking, image reconstruction, data compression, object recognition and so on. Method of refraction or reduced focus can result in objects through boundaries defined by a regular change in intensity. There are some problems of fake edge detection, which include edge localization, missing true edges, problems due to noise and high computational time etc. The focused task is to widely compare various edge detection operators and to make a study over its performances one over the other.

This research paper perceptibly compares four edge detection algorithm namely roberts, sobel, prewitt and canny edge detection operators for extracting edges o f aqua images.

Targeting to detect the edges of any image and then canny algorithm derives analytically optimal step edge operators and proved it a good approximation. And hence performance issues are analyzed in terms of accuracy and speed to conclude the best of working algorithm. And from the experiments, it has been concluded that the canny edge detection algorithm out sources the best.

2. Image Segmentation

Image sharpening and restoration refers to process images that have been captured from the modern camera to make them a better image or to manipulate those images in way to achieve desired result. This includes Zooming, blurring, sharpening, gray scale to color conversion, detecting edges and vice versa, Image retrieval and Image recognition.

Segmentation partitions an image into distinct regions containing each pixel with similar attributes. To be meaningful and useful for image analysis and interpretation, the regions should strongly relate to depicted objects or features of interest. Meaningful segmentation is the first step from low-level image processing transforming a grey scale or color image into one or more other images to high-level image description in terms of features, objects, and scenes. The success of image analysis depends on reliability of segmentation, but an accurate partitioning of an image is generally a very challenging problem.

This method divides the entire image into many sub regions satisfying set of protocols as all the pixels in a particular region must lie in the same gray scale level. And it relies on common patterns in intensity level within a cluster of neighboring pixels. Applying threshold technique, regions can be fragmented depending on range a value, which highly transforms an input image into an output image-segmented binary image.

3. Edge Detecion Algorithms

An Edge detection process is a neighborhood operation used to determine the extent to which each pixel's neighbor can be partitioned by passing a simple arc via some other pixels. In which neighboring pixels of one side of the arc possess a predominant value. And the neighboring pixels of e other side of the arc possess a different predominant value.

3.1 Roberts Edge Detection

The Roberts edge detection operator was introduced by Lawrence Roberts (1965). According to Roberts, an edge detector should have the following properties: the produced edges should be well-defined, the background should contribute as little noise as possible, and the intensity of edges should correspond as close as possible to what a human would perceive. This method computes spatial gradient measurement on an image with utmost fast and easy access. This technique accentuate on regions of high spatial frequency corresponding to edges. Here the input is a gray scale image and in the output, every pixel represents the estimated complete magnitude of the spatial gradient of the input image at that point.

1	0
0	-1

GX

0	1
-1	0

GY

Fig 3.1: Roberts Mask filter in X direction and Y direction.

3.2 Sobel Operator

Sobel edge detection method was introduced by sobel in 1970.this method is highly applied in many areas. It performs a 2-D spatial gradient quantity on an image and thus it detects the edge regions of high spatial frequency. In this method, 3*3 matrix is used, where the first matrix evaluates the gradient in x-direction and the other estimates the gradient in y-direction. The mask is glided over the image, and manipulates the square of pixels simultaneously. Then the algorithm computes the gradient of the image intensity at all individual point. Finally the sobel algorithm directs to increase the intensity of an image at all the pixel points changing from light to dark. Edge boundaries represent the strong intensity contrast depicting either the darkness/brightness.

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

G_X

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

G_y

Fig 3.2: Sobel Mask filter in X direction and Y direction.

$$|G| = \sqrt{G_X^2 + G_y^2} \qquad \ldots\ldots 2.1$$

And its approximation is done by:

$$|G| = |G_X| + |G_Y| \qquad \ldots\ldots 2.2$$

The orientation of angle is given by:

$$\theta = \arctan\left(\frac{G_X}{G_Y}\right). \quad \text{.....2.3}$$

3.3 Prewitt Operator

The Prewitt edge detection was proposed by Prewitt in 1970. It is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each point in the image, the result of the Prewitt operator is either the corresponding gradient vector or the norm of this vector. The Prewitt operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical directions and is therefore relatively inexpensive in terms of computations. This implies that the result of the Prewitt operator at an image point which is in a region of constant image intensity is a zero vector and at a point on an edge is a vector which points across the edge, from darker to brighter values.

The convolution masks of the Prewitt detector are represented below:

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

P_X

-1	0	+1
-2	0	+2
-1	0	+3

P_Y

Fig 3.3: Mask Filter of Prewitt Operator in X direction and Y direction.

Algorithm

Input: Any Sample Image.

Output: Edge detected image.

Step 1: Read the input image.

Step 2: Apply mask Gx, Gy to the input image.

Step 3: Apply prewitt edge detection algorithm and the gradient.

Step 4: Gx, Gy mask manipulated separately on the input image.

Step 5: To verify the total magnitude of the gradient, all the resultant values are combined.

Step 6: Then the absolute magnitude is the detected edges as output.

3.4 Canny Edge Detection

The canny edge Detection method has been widely used and implemented for detecting precision edges. This method takes the foremost priority in addressing itself as most

outstanding in determining the edges from the actual image. As it extracts the specified edges in an image without disturbing its features, it can be proudly stated that the canny has its specialized wings such as lower rate, efficient recognition of edges and a unique-uni response to a single edge. The Canny Edge Detection Algorithm has the following Steps:

Step 1: Smooth the image with a Gaussian filter.

Step 2: Compute the gradient magnitude and orientation using finite-difference approximations for the partial derivatives.

Step 3: Apply non maxima suppression to the gradient magnitude, Use the double thresholding algorithm to detect and link edges.

Algorithm

Inception task: Read the input.

Computational task: Mark the edges of largest gradient.

Notification task: only local maxima should be marked as edges.

Obtaining task: All edges are obtained by hyperesthesia threshold.

Output: finally the output is extracted edge of an image.

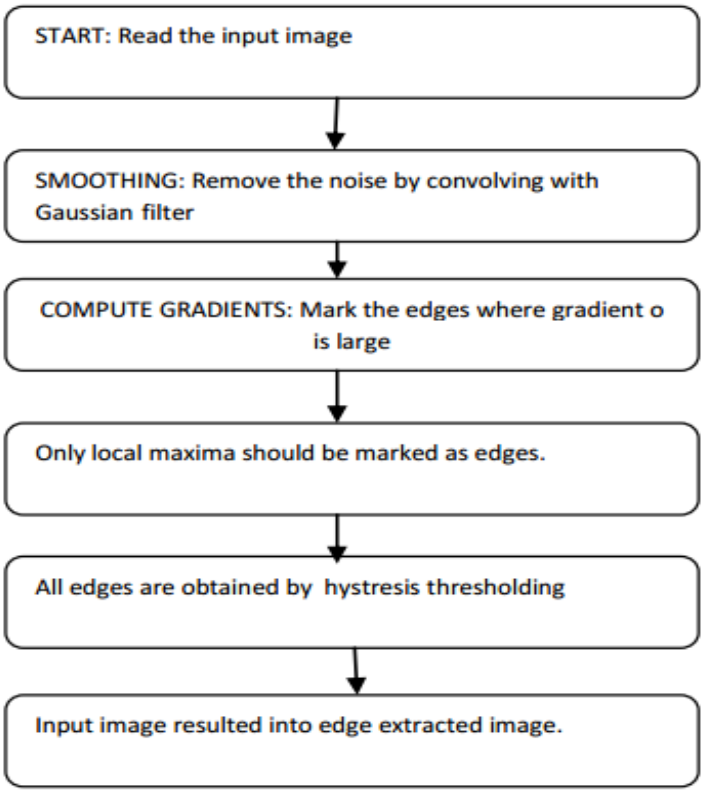
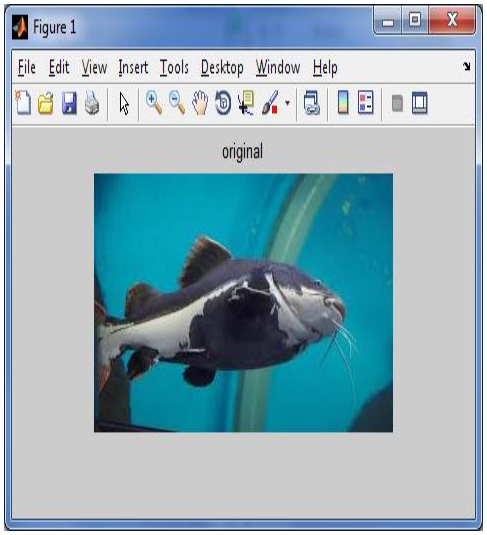
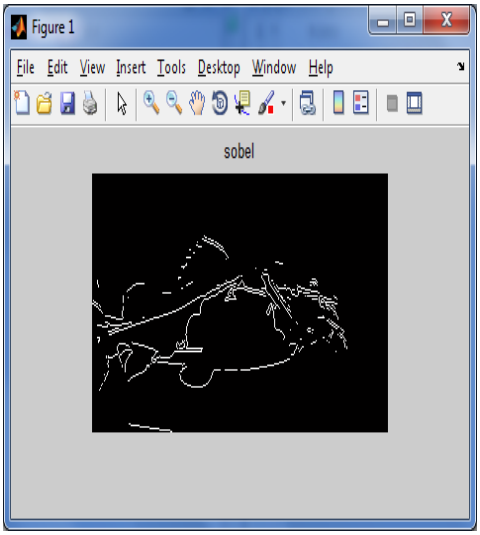


Fig 3.4: Flow chart of canny edge detection.

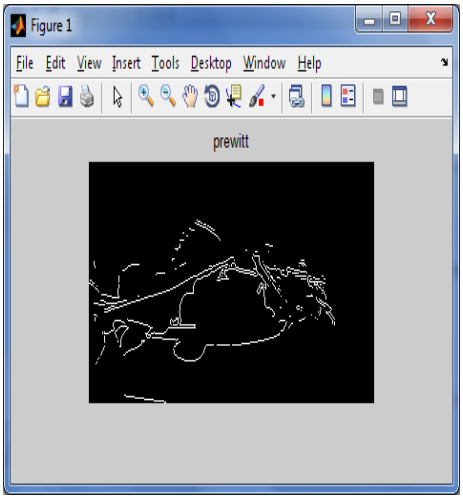
4. EXPERIMENTAL RESULT



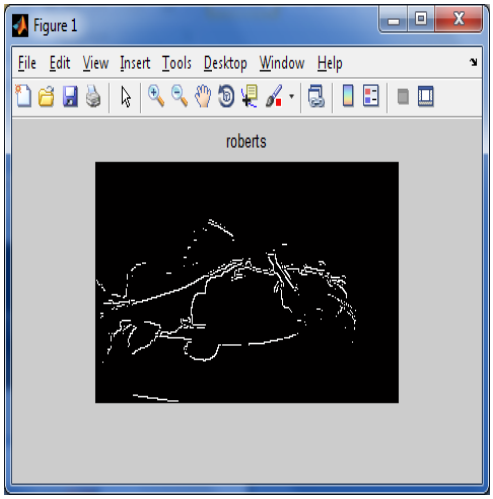
4(a)



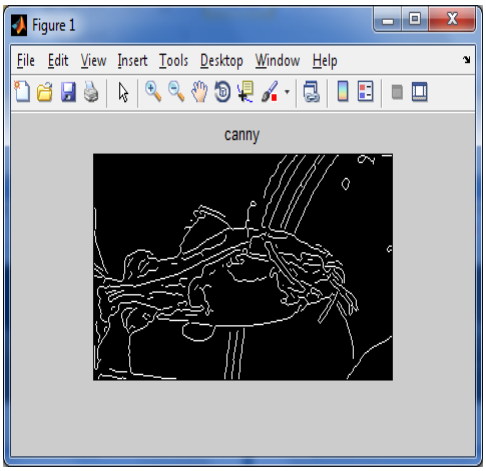
4(b)



4(c)



4(d)



4(e)

4(a). Original image, 4(b). sobel edge detection algorithm 4(c). prewitt edge detection, 4(d). Roberts edge detection, 4(e). canny edge detection.

5. CONCLUSION

Thus, an extensive comparison is made between various edge detection algorithms as Sobel, Roberts, Canny and Prewitt operators for detecting the edges of aquatic images.Since aquatic images have wide applications in medical research, genetic research, medicinal research etc., so by considering all these prominent utilizations of components of aquatic system, the predicted factor in this research has its inception in image acquisition and edge detection, which would ultimately results in good identification and unique determination of actual image species and its feature. And so image processing and edge detection is gaining more prominence in doing research in aquatic system.

Aqua image has been applied to all the above stated algorithms for predicting the best one. Ant it has been concluded that canny algorithm is the best one to detect the edges of aquatic images with respect to execution time.

In future, this research would be extended in detecting the edges of components, particles and organisms of various marine images. Necessary real images would be collected from an ocean and all those images would be applied in MATLAB by using various edge detection algorithms with an objective to determine the best fit in multiple ways such as image clarity, execution time, quick identification of exact image etc. And thus, the next deed and focus is developing an improved canny technique.

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