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Exploring Image Segmentation Techniques to Examine Abnormalities in Brain Images

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KEYWORDS

Brain Images, Image Segmentation, Matlab, Image Processing.

ABSTRACT:

Early brain tumors are a very difficult task for doctors. MRI images are sensitive to noise and other environmental effects. Therefore, since it is difficult for doctors to detect tumors and their causes, we recommend this procedure to detect brain tumors on images. Here we convert the image to grayscale. We use filters for images to remove noise and other environmental effects from the images. The user needs to select the MRI image of the brain. The system will process the image using the image as a step. We use a unique algorithm to detect tumors from brain images. However, the limits of early imaging of brain tumors are not clear. Therefore, we use image segmentation for the image to find the edges of the image. In this method, we use image segmentation to detect tumors. Here we propose an image segmentation process and a set of image filtering techniques to ensure accuracy. This method was implemented in MATLAB.

1. Introduction

Edge detection plays an important role in medical imaging. Users can use edge detection to examine image features to understand significant changes in grayscale. Texture serves as a visual representation of where one part of the image ends and another begins[1,2,3]. Reduces the amount of information in an image while preserving its properties. Performance of the popular and well known edge detection techniques for the image processing is examined in this work in an effort to bring out the best analysis. The principle of our study is to identify tumors from MR-specific brain images and use digital imaging techniques to calculate tumors with high resolution.Early diagnosis of brain tumors is important for effective treatment and improved patient outcomes. Imaging techniques, especially those using MATLAB, provide powerful tools for analyzing medical images and identifying abnormal patterns in the brain[4,5]. This tutorial shows how to use MATLAB to analyze brain tumors, focusing on image processing and analysis techniques.The main aim of the project is to develop a computer-aided detection system for brain tumors in medical images[6,7]. The process involves acquiring brain images, prioritizing them to enhance features, and using image segmentation algorithms to isolate areas of interest that may contain tumors. Finally, the system classifies these areas as tumor or tissue. One of the main purposes of computer vision is to interpret the content of images.Image segmentation is a technique for removing the backdrop of an image so that the contents can be visualized defectively[8]. An important and important part of the picture is its edges. Edge detects the edges of objects in the image. Edge detection is used in image processing, image segmentation and data collection in the fields of computer vision and machine vision by detecting changes in brightness. Since the validity, effectiveness, and potential for the completion of following stages of processing depend on edge detection, it must be effective and dependable. Edge detection satisfies the need by providing all the relevant image information. For this reason, image derivatives are computed[9]. The problem of picture differentiation,

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however, is poorly posed since image derivatives are susceptible to a variety of noise sources, physical and semantic ramifications, as well as the effects of discretization and quantization. Processing is very difficult. Before processing the imag e, it is important to remove unnecessary content it contains. After removing unnecessary elements, the im age can be processed. The first step in painting is the fi rst picture. Preprocessing involves converting the imag e to grayscale, removing noise, and reconstructing the image. It is the most advanced application to conver t to grayscale images[10]. Once the image is converted to grayscale, different filtering techniques are used to r emove noise. Digital images generally consist of pixels, which are small boxes that represent the color and brightness of a point in the image[12]. Image processing involves using pixels in the desired order to achieve the desired effect in the image. Most of the work done on digital images involves filtering, enhancing, retouching, etc. includes transactions. Filtering is the process of removing unnecessary noise from an image[13]. This is done using filters that adjust the pixel values of the image. Depending on the filter type, they can be used in different applications[14]. They can be designed to eliminate certain sounds, such as Gaussian noise, salt and pepper noise, or speckle noise. Filters that help remove the above noise include median filters, band pass filters, and Gaussian filters[15].

2. Methods

MRI images are magnetic resonance images that can be obtained on a computer when the MRI machine scans the patient. We can acquire MRI images of the part of the body which is under test or desired. Generally when we see MRI images on a computer they look like black and white images. In analog practice, gray scale imaging is sometimes called "black and white," but technically this is a misnomer. In true black and white, also known as halftone, the only possible shades are pure black and pure white. The illusion of gray shading in a halftone image is obtained by rendering the image as a grid of black dots on a white background (or vice versa), with the sizes of the individual dots determining the apparent lightness of the gray in their vicinity. The halftone technique is commonly used for printing photographs in newspapers and as MRI image is taken on computer then In the case of transmitted light (for example, the image on a computer display), the brightness levels of the red (R), green (G) and blue (B) components are each represented as a number from decimal 0 to 255, or binary 00000000 to 11111111. R = G = B for each pixel in a red-green-blue (RGB) grayscale image. The brightness of gray is proportional to the number representing the brightness level of the primary color. Black is represented by R=G=B=0 or R=G=B=00000000, while white is represented by R=G=B=255 or R=G=B=11111111. Because there are 8 grayscale objects represented in the binary system. This measurement method is called 8-bit grayscale.

The Sobel operator measures the two-dimensional spatial gradient of the image, thus highlighting high spatial frequency regions corresponding to edges. It is generally used to find the approximate true gradient magnitude at each point in the grayscale input image. The energy gradient is calculated using a filter based on the Gaussian derivative. Compared to Gaussian, image noise is less noticeable. Then, pixels with insufficient gradient size are removed and the resulting edges are reduced to a 1-pixel curve. For edge detection, the Sobel filter is used, which works by calculating the image using the gradient of each pixel in the image. It determines the angle and speed at which the fastest transition from light to dark occurs. The most commonly used method, compound median filtering with the Sobel operator or compound average denoising with the Sobel operator, cannot remove noise and noise. In this study, firstly, soft wavelet was used to remove noise, and then a Sobel edge detection operator was used to identify the edges of the image. The computational speed of the Sobel operator is slower than that of the Roberts Cross operator, but the larger convolution kernel further smoothes the input image, making the operator less noisy. This operator also generally produces more results than Roberts Cross for similar margins.

Canny edge detection uses linear filtering with a Gaussian kernel to smooth noise and then calculates edge intensity and direction for each pixel in the smoothed image. Candidate edge pixels are defined as pixels that survive an optimization process called thresholding. During this process, if the edge strength of each candidate edge pixel is not greater than the edge strength of two adjacent pixels in the gradient direction, the edge intensity is set to zero. The thinned edge amplitude image is then thresholded using hysteresis. If hysteresis occurs, it starts to be applied to both sides. All candidate edge pixels below the lower threshold are

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marked as non-edges, and all pixels above the lower threshold that can be connected to pixels above the threshold by chains of edge pixels are marked as edge pixels. As the conventional Canny edge detection technique is noise-sensitive and as a process of removing noise, it may lead to loose weak edge information. Its fixed parameters exhibit poor adaptability. This work put up an enhanced Canny algorithm to address these issues. With the help of this technique, the idea of gravity field intensity was proposed as a replacement for picture gradient. For two different types of typical images, two adaptive threshold selection techniques were proposed, each based on the mean of the image gradient magnitude and standard deviation. The linear fitting method was used to obtain the final image edge detection findings. According to experimental findings, the new algorithm can distinguish between targets and background with more clarity and is more noise-resistant.

The Roberts Edge detection operator performs simple, fast, two spatial gradient measurements on an image. Therefore, the spatial frequency field usually corresponding to the edges is very important. In its most common use, the input to the operator is a grayscale image and hence the output. The pixel value of each point in the output represents the approximate magnitude of the spatial slope of the input image at that point. The discrete differentiation, the gradient-based operator, calculates the sum of squares between diagonally adjacent pixels in the picture. In image processing, edge detection is one of the techniques for identifying the edges of objects in the picture.

Gray scale image is then used as input to the advanced filter. A high pass filter is the basis of most sharpening methods. The image becomes sharper when the contrast between adjacent areas is increased and there is little change in brightness or darkness. High frequency filters will preserve high frequency information in the image while reducing low frequency information. The core of the high pass filter is designed to increase the brightness of the pixel position relative to neighboring pixels.

3. Results

SAMPLE 1:

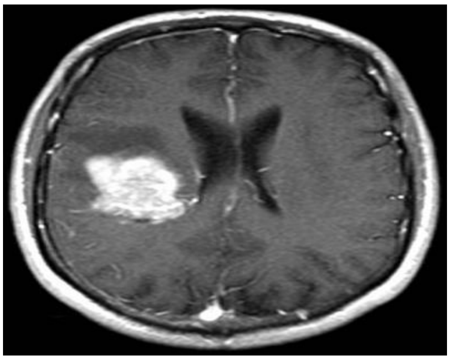

Fig a. Original image

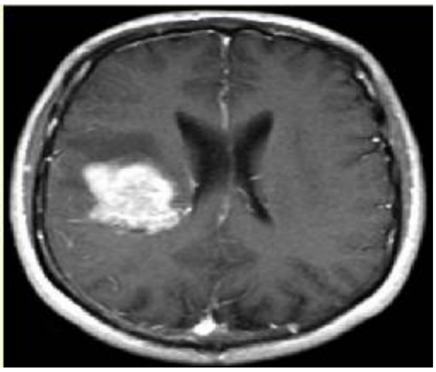

Fig b. Grayscale Image

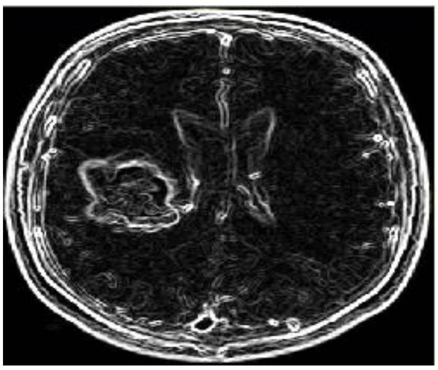

Fig c. Sobel Edge Detection

Fig d. Canny Edge Detection

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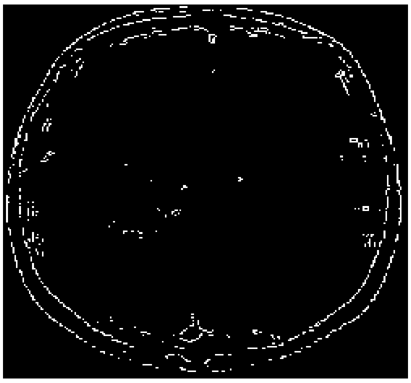

Fig e. Roberts Edge Detection

Fig 1: Output of edge detection techniques

SAMPLE 2

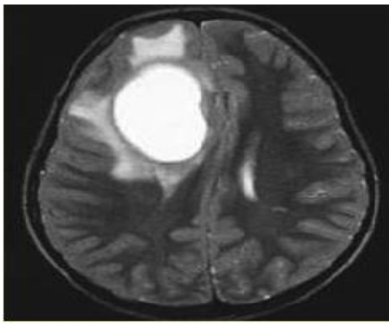

Fig a. Original image

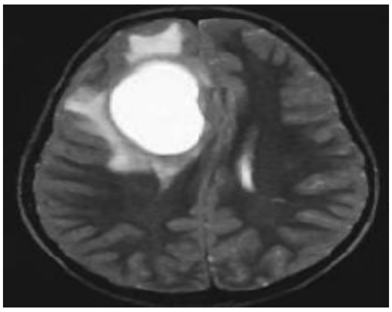

Fig b. Grayscale Image

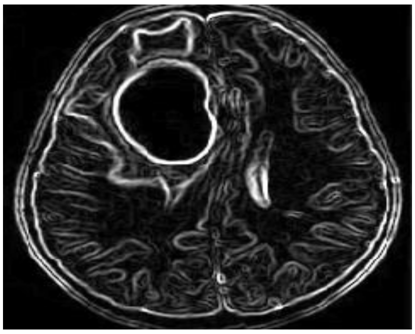

Fig c. Sobel Edge Detection

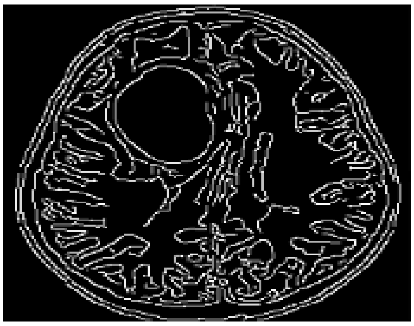

Fig d. Canny Edge Detection

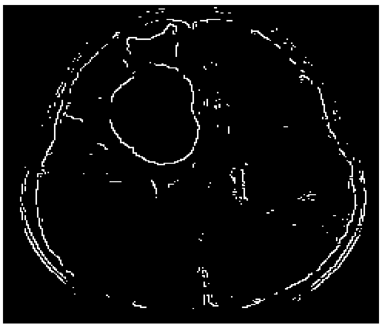

Fig e. Roberts Edge Detection

Fig 2: Result of Sample 2

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QUALITATIVE ANALYSIS

SAMPLE 1

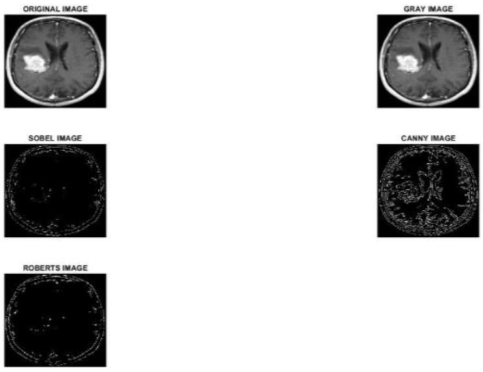

Fig 3: .Result of Sample 1

QUANTITATIVE ANALYSIS :

Edge Strength (Sobel Edge Detection) : 8.15

Edge Strength (Canny Edge Detection) : 9.44

Edge Strength (Roberts Edge Detection) : 8.21

QUALITATIVE ANALYSIS

SAMPLE 2

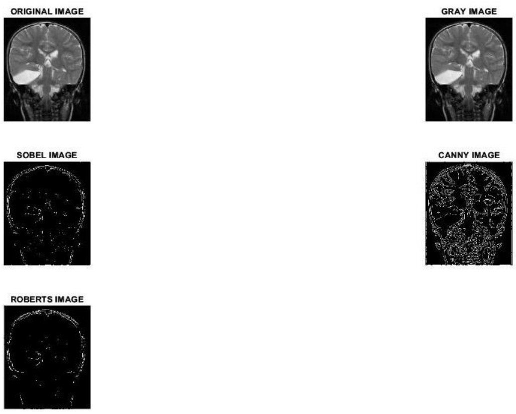

Fig 4: .Result of Sample 2

QUANTITATIVE ANALYSIS :

Edge Strength (Sobel Edge Detection) : 8.23

Edge Strength (Canny Edge Detection) : 9.64

Edge Strength (Roberts Edge Detection) : 8.52

Fig : Sobel Edge Detection

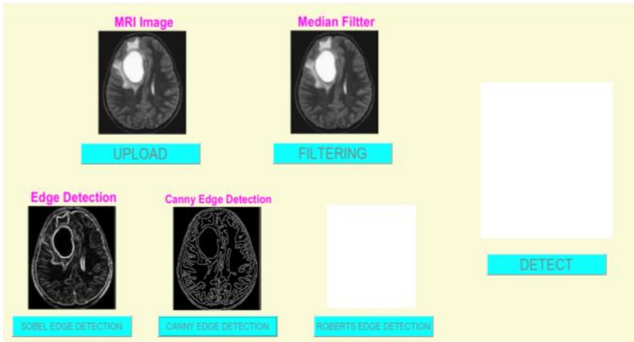

Fig : Canny Edge Detection

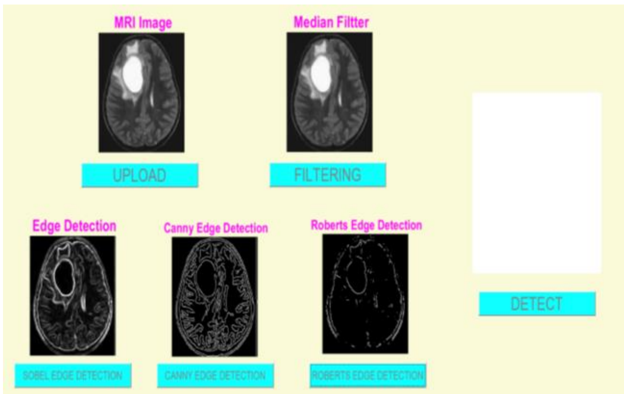

Fig : Robert Edge Detection

Table 1 : Quantitative analysis of three different edge detection techniques

TECHNIQUE NAME: / SAMPLE NO:	SOBEL EDGE DETECTION	CANNY EDGE DETECTION	ROBERTS EDGE DETECTION
1	8.15	9.44	8.21

2	8.23	9.64	8.52
3	7.72	8.24	7.72
4	7.5	8.67	7.59
5	7.89	8.51	7.3

CONCLUSION:

With image segmentation, image filtering, and grayscale conversion, the early identification of brain abnormalities approach offers a viable answer to the challenges faced by medical experts. Different techniques were used in MATLAB to increase the accuracy of abnormality identification using MRI images. Even in the uncertain early imaging era, our bespoke image processing approach provides users with an appropriate response. All things considered, this approach which combines the most advanced techniques offers efficiency throughout the search for precise and prompt brain tumor diagnosis, perhaps improving patient outcomes in the clinical setting. Future developments in medical imaging and diagnostics could greatly benefit from the use of MATLAB for edge and tumor detection. By incorporating deep learning techniques, edge detection accuracy can be improved, leading to more accurate anatomical structure delineation. Furthermore, the integration of machine learning methodologies might enhance the efficiency of tumor identification, facilitating rapid treatment and diagnosis strategy. MATLAB's real-time processing capabilities can help with the quick and automated solutions that are being developed for medical image analysis. The integration of MATLAB with new imaging modalities and computational techniques is going to be crucial in advancing medical research and healthcare procedures as technology develops.

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