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CYST DETECTION IN MRI BRAIN IMAGE

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ABSTRACT

In medical diagnosis, the cyst detection in human brain is very difficult and intricate task. The task has been carried out by the help of image processing to make simple and easier. Since a long period of time, image processing has helped a lot for various pathological tasks and still an emerging area of research. Medical diagnosis became fast due to such type of advanced techniques. In this work, an approach has been attempted to detect the cyst in the MRI brain image. The brain image has been considered to detect the cyst. A simple method of segmentation and edge detection will be applied for the purpose of detection. The analysis will be performed using different structuring elements of the medical image.

KEYWORDS: Cyst Detection, Diagnosis, Segmentation, Edge Detection

INTRODUCTION

The aim of our task is to find out a cyst from a particular MRI scan of a brain image using digital image processing techniques. Cyst in the brain is a sphere filled with fluid, similar to a miniature balloon filled with water. Cyst may contain fluid, minerals or tissues. Although they are benign, cysts are not always harmless. A cyst can occur anywhere on the body. It may be formed on the skin surface or on soft tissue. The outer wall of a cyst is called a capsule. The symptoms of a cyst depend on where the cyst is located. In some cases, the cysts can block the circulation of cerebrospinal fluid (CSF) and cause hydrocephalus, leading to headache, nausea and vomiting, double vision, or seizures. In others, a cyst may cause memory disturbances and behavioural problems. There are hundreds of different types of cysts that can arise in the body. The most common types of cyst found in the brain are arachnoid, colloid, dermoid, epidermoid and pineal cyst. Cyst patients may be referred for a screening MRI and an early diagnosis would allow patients to choose pre-emptive treatment. This not only spares them from developing symptoms, but it lets them avoid the low but real risk of sudden death. Diagnosis is usually made based on neuro-imaging, and both CT and MRI can be used to this effect. These imaging modalities can often exhibit the cystic structure that is blocking the flow of CSF as well as any associated hydrocephalus. Medical Imaging has had a great impact on the diagnosis of diseases and surgical planning.

The goal of segmentation is to subdivide an image into its constituent regions or objects that have similar features according to a set of predefined criteria. Image segmentation is normally used to locate objects and boundaries (curves, lines etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

Edge detection is a method to discover the edges of an image which are very important features of an image. It provides image information that can be used for image analysis. Edge points are those points in an image which have a different intensity from the adjacent points. The points at which intensity changes forms the edge points. Edges define the boundaries between regions in an image, which helps with segmentation and object recognition.

Magnetic resonance imaging (MRI), nuclear magnetic resonance imaging (NMRI), or magnetic resonance tomography (MRT) is a medical imaging technique used in radiology to visualize internal structures of the body in detail. MRI makes use of the property of nuclear magnetic resonance (NMR) to image nuclei of atoms inside the body. An MRI scanner is a device in which the patient lies within a large, powerful magnet where the magnetic field is used to align the magnetization of some atomic nuclei in the body, and radio frequency fields to systematically alter the alignment of this magnetization. This causes the nuclei to produce a rotating magnetic field detectable by the scanner and this information is recorded to construct an image of the scanned area of the body. Magnetic field gradients cause nuclei at different locations to rotate at different speeds. By using gradients in different directions 2D images or 3D volumes can be obtained in any arbitrary orientation.

MRI provides superior contrast between the different soft tissues of the body, which makes it especially useful in imaging the brain, muscles, the heart, and cancers compared with other medical imaging techniques such as computed tomography (CT) or X-rays. Unlike CT scans or traditional X-rays, MRI does not use ionizing radiation. MR is generally more sensitive in detecting brain abnormalities during the early stages of disease, and is excellent in early detection of cases of cerebral infarction, brain tumors, or infections.

LITERATURE SURVEY

Su Ruan, Cyril Jaggi, Jinghao Xue, Jalal Fadili, and Daniel Bloyet [1] have presented a Brain Tissue Classification of Magnetic Resonance Images Using Partial Volume Modeling. This paper presents a fully automatic three-dimensional classification of brain tissues for Magnetic Resonance (MR) images. A promising method is presented for segmenting WM, GM and CSF volumes using a 3-D MRF model. The algorithm is unsupervised, fully automatic, and uses only T1-weighted images. Mixtures of multiple tissue types within a voxel are taken into account in the process of classification. The Gaussian distribution of the mixel intensities is demonstrated, which allows us to simplify the image model, as well as the segmentation method.

Sometimes, it is difficult to distinguish the benign tumor from malignant ones. With the aid of image processing methods such as mathematical morphology which define the edge of the images, it becomes easier to identify the sizes, shapes and characteristics of pathologic cell images [2]. The edges of an image always include inherent information (such as direction, step character, shape, etc.), which are significant attributes for extracting features in image recognition. In most cases, pixels along an edge change gradually, whereas those perpendicular to the direction of the edge usually have much sharper changes.

Many authors used properties of wavelet transform coefficients and multi resolution theory only [3,4] for the segmentation of images but a composite feature vector comprising of wavelet and statistical parameters in contrast to other researchers who have developed feature vectors either using statistical parameter or using wavelet parameters. Generally speaking, arithmetic for edge extraction is to detect whether mathematical operators of the pixels are coincident with the features of the edge. In the past two decades several algorithms were developed to extract the contour of homogeneous regions within digital image. Edge detection is a problem of fundamental importance in image analysis. In some images, edges are nothing but the object boundaries and they are useful for partition, registration and recognition of objects in a scene.

Tao Wang, Irene Cheng and Anup Basu [5] have presented a Fluid Vector Flow and Applications in Brain Tumor Segmentation. This paper present a new approach that we call the "fluid vector flow" (FVF) active contour model to address problems of insufficient capture range and poor convergence for concavities. A new parametric FVF active contour model to address the issues of limited capture range and the inability to extract complex contours with acute concavities. Experiments on synthetic images and head MRI images show that FVF produces better results compared to GVF, BVF, and MAC. Quantitative experiments on brain tumor images show that FVF has the largest mean (0.61) and median (0.60) with smallest standard deviation (0.05) using TM. Mixed effects model with random data and test effects is used to statistically compare the differences between FVF and other three methods.

S. Priyadarshini and G. Sahoo [6] have presented a new edge detection method that gives better edge detection accuracy. The paper proposed a new technique of edge detection that requires much lesser computation than Sobel's method and performs better than Sobel's method. The technique is based on additions and divisions.

Nandita Pradhan & A.K. Sinha [7] have presented a Fuzzy Ann Based Detection and Analysis of Pathological And Healthy Tissues In Flair Magnetic Resonance Images Of Brain by using a computational technique is proposed for the segmentation, detection and analysis of pathological tissues, healthy tissues and Cerebrospinal fluid (CSF) of brain with the help of FLAIR brain magnetic resonance images. Composite feature vectors are extracted from the blocks of size 4×4 pixels of intra-cranial brain image.

Lei Guo, Lei Zhao, Youxi Wu, Ying Li, Guizhi Xu, and Qingxin Yan [8] have presented a Tumor Detection in MR Images Using One-Class Immune Feature Weighted SVMs. This paper presents immune algorithm (IA) was introduced in searching for the optimal feature weights and the parameters simultaneously. One-class immune feature weighted SVM (IFWSVM) was proposed to detect tumors in MR images.

L. Weizman and L. Ben Sira [9] have presented an automatic method for the segmentation, internal classification and follow-up of optic pathway gliomas (OPGs) from multi-sequence MRI datasets.

Shreetam Behera, Mihir Narayan Mohanty, Arabinda Mishra, [10] have presented a Cyst Detection an Image Processing Approach by using morphological analysis. The brain image has been considered to detect the cyst. A simple method of morphology in a new way has been applied for the purpose of detection. The morphological analysis is performed using different structuring elements of the medical image.

Ashika Raj [11] have presented a paper on Detection of Cysts in Ultrasonic Images of Ovary, Ultrasound imaging of the follicles gives important information about the size, number and mode of arrangement of follicles, position and response to hormonal stimulation. A thresholding function is applied for denoising the image in the wavelet domain. Before the segmentation process the ultrasonic image is preprocessed using contrast enhancement technique. Morphological approach is used for implementing contrast enhancement. This is performed in order to improve the clarity and quality of the image. Fuzzy c-means clustering algorithm is applied to the resultant image. Finally the cysts are detected with the help of clusters.

PROPOSED METHOD

We have used these basic concepts to detect cyst in our paper, the component of the image hold the cyst generally has extra concentration then the other segment and we can guess the location, count no. of infected cyst pixel and calculate percentage of infection of cyst in the image.

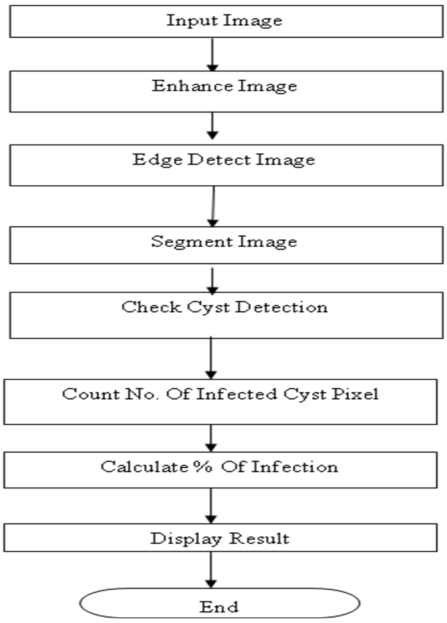

Figure 1: Data Flow Diagram of Proposed Method

Initially, an input image is taken in which cyst is to be detected. Then enhance the image. Image Enhancement is the improvement of digital image quality, without knowledge about the source of degradation. It is the technique to improve the interpretability or perception of information in images for human viewers [12]. It is to improve the image quality so that the consequential image is better than the new image for a specific application. Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured [13]. Enhancement may be used to restore an image that has suffered some kind of deterioration due to the optics, electronics and/or environment or to enhance certain features of an image.

There are various ways to perform edge detection. In this work canny edge detection method is used for good result. Then, a segmentation algorithm is applied to segment the desired part of the image and detect the cyst. Medical image segmentation refers to the segmentation or partition of known anatomic structures from medical images. Structures of interest include organs or parts thereof, such as cardiac ventricles or kidneys, abnormalities such as tumors and cysts, as well as other structures such as bones, vessels, brain structures etc. It has been used for cyst or tumor recognition as well as for find out cyst or tumor boundaries. Image segmentation techniques [14] are mostly used in medical field for detecting diseases in human body structures such as nerves damage, blood vessels extraction and tumor detection.

The overall objective of such methods is to assist doctors in evaluating medical imagery or in recognizing abnormal findings in a medical image. Image segmentation is an essential process for most image analysis techniques. Segmentation subdivides an image into its constituent parts. Segmentation algorithms are based on one of the two properties of intensity values, namely discontinuity and similarity. First category is to partition an image based on abrupt changes in intensity, such as edges in an image. Second category is based on partitioning an image into regions that are similar according to predefined criteria. If the cyst is present in MRI brain image, then Count No. of infected cyst pixel and Calculate % of infection then display the result. Pre-processing is a common name for operations with images at the lowest level of abstraction both input and output are intensity images. A pre-processing phase is needed in order to improve the image quality and make the segmentation results more accurate. The intention of these steps is fundamentally to recover the image and the image superiority to get more guarantee and ease in identify the cyst.

Algorithm for Cyst Detection

Step 1: Read input MRI brain image.

Step 2: Enhance image

Step 3: Compute Edge detection by using edge detection technique.

Step 4: Segment image

Segmentation is applied to segment the desired part of the image. Image segmentation by thresholding is a straightforward but powerful approach for segmenting images having light objects on dark background

Step 5: Check Cyst detection

Step 6: Count No. of infected cyst pixel

Step 7: Calculate % of infection.

(Total no. of infected cyst pixels * 100) / Total pixels in skull image = Percentage of infection

Step 8: Display result

Step 9: End

Experimental Result

Results are shown below with image name A1.

Figure 2 is the MRI scan image; Figure 3 shows Enhanced Image; Figure 4 shows Edge Detect Image by using Canny edge detection method; Figure 5 shows segment image with location of cyst; Figure 6 shows output with Cyst location and figure 7 shows Final output with cyst portion only.

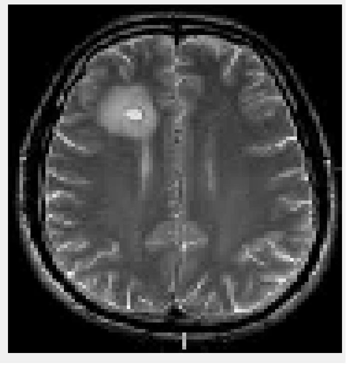

Figure 2: Original Input Image

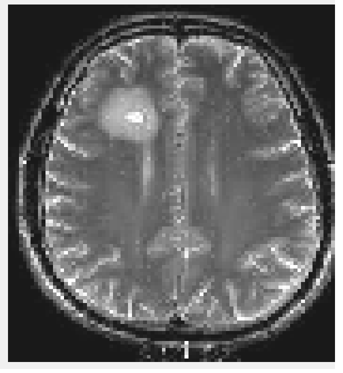

Figure 3: Enhanced Image

Figure 4: Edge Detect Image

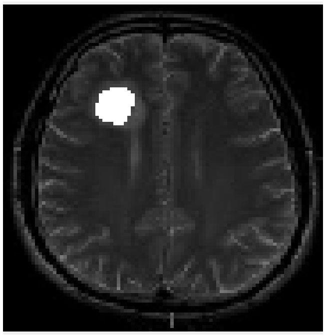

Figure 5: Segment Image

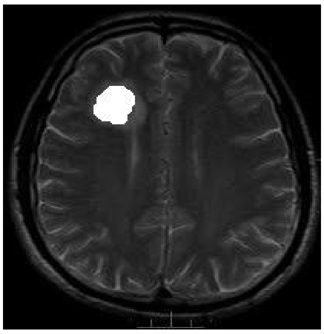

Figure 6: Output with Cyst Location

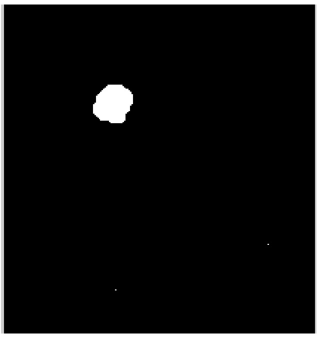

Figure 7: Final Output with Cyst Portion

Table 1: Contains Image Size with Skull Size and Cyst Size in Pixels

Sr. No.	Image Name	Image Size	Skull Size	Cyst Size
1.	Image1.jpg	134 × 135	36839	578
2.	Image2.jpg	120 × 145	20119	452
3.	Image3.jpg	117 × 145	48827	2029
4.	Image4.jpg	120 × 145	21862	292

Table 2: Count No. of Infected Cyst Pixel and Calculate % of Infection

Sr. No.	Image Name	Total Pixels in Input Image (Skull + Background)	Total Pixels in Skull Image	Total Infected Cyst Pixels	Total % of Cyst Infection
1.	Image1.jpg	50400	36839	578	1.569 %
2.	Image2.jpg	27482	20119	452	2.246 %
3.	Image3.jpg	66871	48827	2029	4.155 %
4.	Image4.jpg	29952	21862	292	1.335 %

Cyst Detection Result

This table and figure shows a cyst detection rate. In this table here we tested recognition rate on images i.e. .jpg, .png, .bmp, .tiff images which have no effect on rate. The recognition rate calculated by actual cyst presented in images with respect to cyst detected from them. At most it gives 100% recognition rate.

Table 3: Cyst Detection Result

Sr. No.	Input Image Name	Actual Cyst Present in Input Image	Cyst Detected	Recognition Rate	Cyst Recognized
1.	Image1.jpg	01	01	100%	Yes
2.	Image2.jpg	02	02	100%	Yes
3.	Image3.jpg	01	01	100%	Yes
4.	Image4.jpg	01	01	100%	Yes

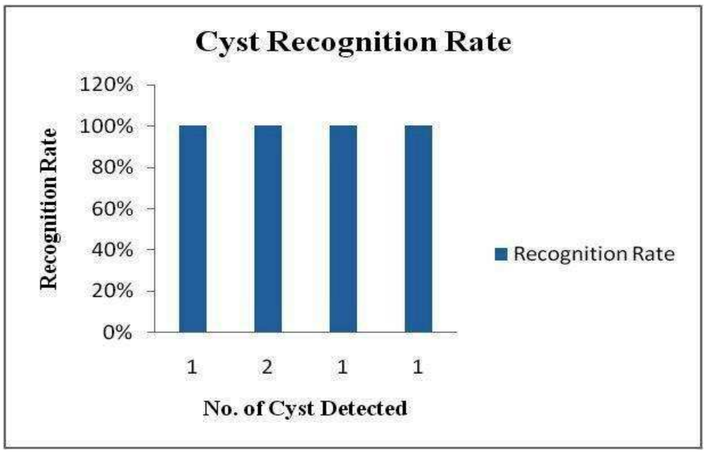

Figure 8: Graph of Recognition Rate

Some Other Results are Shown below

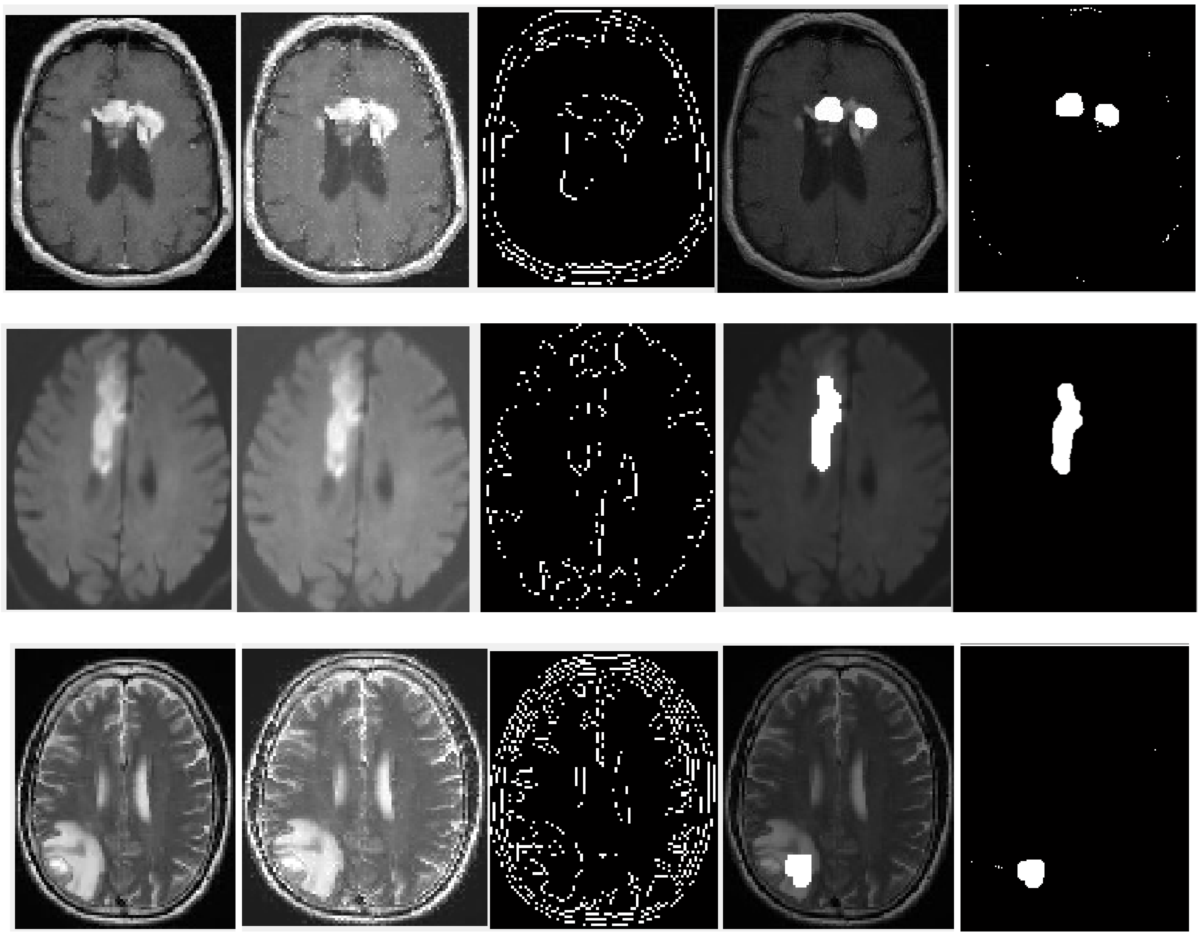

Figure 9: Shows the Output Image with Different Input MRI Image Where A2, A3, A4, are the Different Input Image Name and B1, B2, B3, B4, B5, B6 are the Input Image, Enhanced Image, Edge Detect Image, Segment Image and Final Output with Cyst Portion Only

CONCLUSIONS

In medical diagnosis, the cyst detection in human brain is very difficult and complex task. The task has been carried out by the help of image processing to make simple and easier. The cyst can be found precisely according to check cyst image part in MRI brain image and exact position of the infected area, this work can help the doctors for the analysis of the cyst and also count the number of infected cyst pixel i.e. in which calculate percentage of infection.

Success of MRI in the treatment of brain pathologies is very encouraging but still diagnosis and locations of lesions are made manually by radiologists. It consumes valuable human resources and making it prone to error. To overcome this problem here we develop a robust model for cyst detection in MRI brain image, which is a challenging task.

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