Cyst Detection in Brain using Neural Network

Sheena Jagga
M.Tech CSE
Mody University, Lakshmangarh
sheenajagga@gmail.com

Suneet Gupta
Asst. Prof, Modi University
Lakshmangarh
suneetgupta.fet@modyuniversity.ac.in

ABSTRACT- Cysts occur within tissue and can affect any part of the body. Cysts in brain can sometimes block the circulation of cerebrospinal fluid (CSF) causing hydrocephalus which can lead to nausea, headache, vomiting and double vision. This paper proposes a strategy to detect cyst and also find the percentage of infection along with the perimeter of cyst using various image processing techniques. The methodology proposed give efficient results.

INDEX TERMS- Cyst, Morphological operations, MRI.

I. Introduction

Cyst refers to an abnormal sac or pocket in the body that contains either liquid, gaseous or semi-solid substances. They vary in size from microscopic to the size of some team-sport balls. Large cysts can displace internal organs. Most cysts are benign and are caused by plugged ducts or other natural body outlets for secretions. However, some cysts may be tumors and are formed inside tumors, these can be potentially malignant. Examples include dermoid cysts [1]. The treatment cyst depends on its size, type and grade.

Imaging plays a vital role in the diagnosis and treatment planning of cysts present in brain. Imaging can be done by CT scan, Ultrasound and MRI etc. The MR imaging method [2] is considered to be the best due to its higher resolution.

Image processing techniques are used for an informative detection. The primary step in image analysis is pre-processing of MRI images which performs image enhancement using noise reduction techniques and after applying some morphological operations image is segmented.

The objective of this research is to present cyst in the form which is easily recognizable even by a nonprofessional.

2. Methodology

The methodology used in this paper is described in following steps:

1. Load MR Image of a brain.
2. Perform image filtering.
3. Apply morphological operations
4. Perform image segmentation.
5. Applying neural network.
6. Generate results.

A. Loading Image

MR Image appears black and white on computer screen. Converting MR Image to grayscale eliminates the hue and saturation information while retains the luminance. Grayscale gives range of shades of gray without apparent color. The darkest feasible shade is black, which is the total absence of transmitted or reflected light while the lightest possible shade is white, the total transmission or reflection of light at all visible wavelengths [5]. For these reasons we first convert our MR Image to grayscale.

B. Image Filtering

Median filter is a nonlinear digital filtering technique, often used to remove noise. This noise reduction is a vital pre-processing step to improve the results of later processing. Median filtering is very widely used in digital image processing because under certain conditions, it preserves edges while removing noise [3].

C. Morphological Operations

Morphology refers to a particular shape or form. Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. Morphological techniques probe an image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighborhood of pixels [4]. The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image [5].

D. Image Segmentation

Image Thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary

images. It is most effective in images with high levels of contrast.

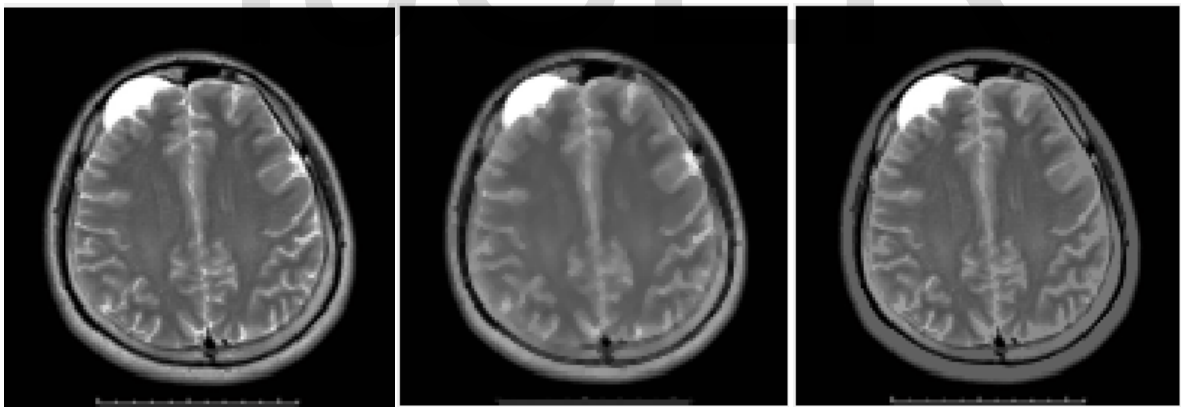
E. Feature Extraction

The following features are extracted from the segmented image using *regionprops*:

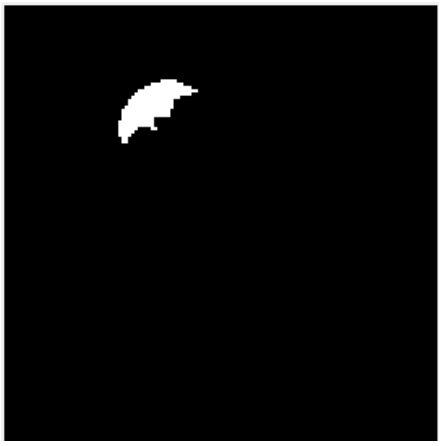
1. Area
2. Perimeter of cyst
3. Eccentricity
4. Length of major axis
5. Length of minor axis
6. Euler number
7. Extent
8. Centroid
9. Bounding box
10. Radius

F. Applying Neural Network

Extracted features are used to train the neural network, positive samples (Cyst is present) are trained by 1 and negative samples (Cyst is absent) by 0. Now this trained neural network will give the output value 1 for image that contains Cyst and for others it will give 0. After training we classify Cystic and non cystic MR Images. At last we get trained network, if we test any positive and negative samples it give proficient results.



(a) (b) (c)



(d)

Fig. 1. Illustration of Methodology (a) Original Image (b) Filtered Image (c) After applying erosion and dilation (d) Segmented Cyst

G. Results

In this proposed system 90 Brain MRIs are used for training and 30 for testing. Out of 90, 45 are cystic which are trained by 1 and other 45 are non cystic, trained by 0. The accuracy of the algorithm is calculated using the formula

AC= (TP+TN)/ (TP+TN+FP+FN)*100

TP: Predicts cystic as cystic

TN: Predicts non cystic as non cystic

FN: Predicts cystic as non cystic

FP: Predicts non cystic as cystic

The accuracy was found to be 90.00 %.

3. Conclusion

In medical diagnosis detection of cyst is an intricate task. Image processing techniques along with neural network are used to make this task easy. It is a radiologist's task to give the information regarding the lesions but human resources are prone to errors and consume valuable time. The developed methodology can render help to get accurate computerized information about the cyst. In future methods can be developed to detect cyst according to its type.

4. References

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