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RESEARCH PAPER

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BRAIN TUMOUR DETECTION AND SEGMENTATION

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Abstract: Brain tumour is an abnormal growth caused by cells reproducing themselves in an uncontrolled manner. Curing cancer has been a major goal of medical researchers for decades. The early detection of cancer can be helpful in curing the disease completely. An Artificial neural network-based approach to identify brain tumour from MRI images can help in quicker more efficient detection. The main objective of the project is to help identify and classify brain tumours by training an Artificial Neural Network on MRI scans of various tumour free brains as well as brains with tumours to allow the system to learn how to classify unseen MRI This paper describes the strategy to detect & extraction of brain tumour from patient's MRI scan images of the brain. This method uses some noise removal functions, segmentation and morphological operations from the basic concepts of image processing. The process of tumour detection and elicitation of the tumour from the image is done using MATLAB.

Keywords: MATLAB, MRI images, ANN, Brain tumour

INTRODUCTION

Brain tumor is an abnormal growth of cells where they form a lump of cells because of uncontrolled growth and division of cells. The normal cells transform into carcinogenic cells which become unable to inhibit growth and hence result in uncontrolled growth of cells. There are two types: malignant tumors and benign tumors. Malignant tumors can be divided into primary tumours and secondary tumours. Primary tumours grow within the brain, secondary tumors that have migrated from some other part of the body, also known as brain metastasis tumors. Magnetic Resonance Imaging (MRI) is the most advance medical imaging technique which results in high resolution images of the human body parts. MRI images allow the doctors to locate and diagnose any abnormalities in the body. The images help the doctor in identifying the location, shape and size of the brain tumour and it's behaviour of spreading. Several methods like fuzzy methods, neural networks, knowledge-based techniques, variation segmentation are used to classify MRI scans. The MRI scans provides complete understanding of the tumour in a non-invasive way and it's properties so as to allow it'd operation safely [1]. MRI provides an enhanced and high-resolution image as compared to CT Scans or X ray images. The MRI image is primarily pre-processed in order to make is enhanced and noise free, this leads to a better-quality image, then morphological functions are operated upon the image to detect the tumour. The morphological operations are applied on the assumptions made about the shape and size of the tumour and then the tumour is mapped on the grayscale image [2]. Evidently, there a large amount time required to read and diagnose the tumour which is a lot of work, an automated system which will be able to do this in advance will be very beneficial and time saving.

LITRATURE SURVEY

The existing method is based on the thresholding and region growing. The thresholding method was ignored the spatial characteristics. Normally spatial characteristics are important for the malignant tumor detection. In the thresholding based segmentation the image is considered as having only two values either black or white. But the bit map image contains 0 to 255 gray scale values. So sometimes it ignores the tumor cells also. In case of the region growing based segmentation it needs more user interaction for the selection of the seed. Seed is nothing but the center of the tumor cells; it may cause intensity in homogeneity problem.[2]

Another scheme used consists of four parts: image pre-processing, feature extraction using Rough Set Theory and then classification based on Feed Forward Neural Network. Image pre-processing techniques are applied to improve the quality of image.[3] Texture feature extraction techniques are used for the purpose of feature extraction from MRI brain images. [4] Feed Forward Neural Network classifier is utilized to perform two functions. The first is to differentiate between normal and abnormal. The second function is to

classify the type of abnormality in benign or malignant tumor.[5]

PROJECT DESIGN

System Architecture:

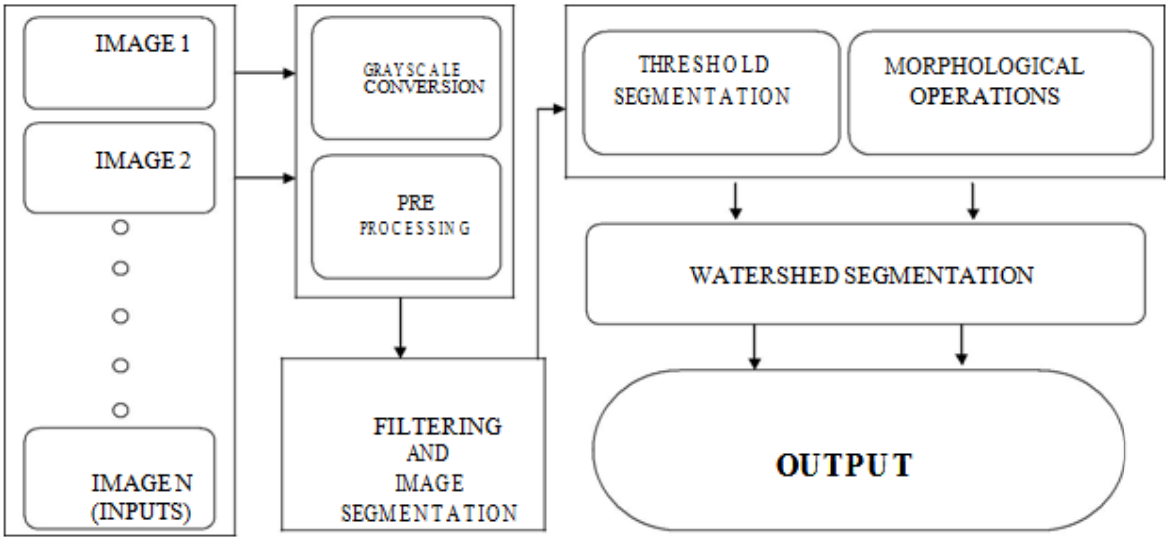

Fig 1. System Architecture Of Proposed Model

METHODOLOGY

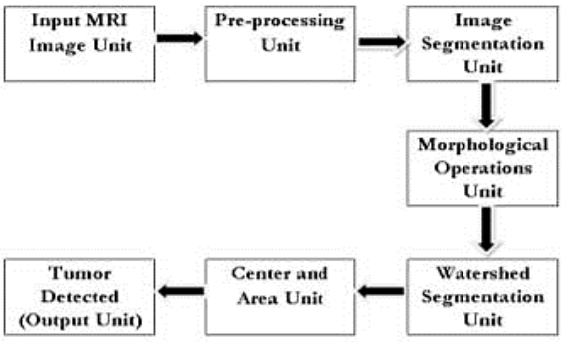

Fig 2. A block diagram of Brain Tumor Detection

There are various approaches to perform automated scanning and segmentation on MRI images, the most basic steps to do the task include, Pre-processing of the image, feature extraction to distinguish between healthy and unhealthy brain [6].

There are two main steps in the process, first is pre-processing the MRI images and the perform segmentation and morphological operations.

The steps are as follows: -

- MRI images, the initial input, is scanned
- The input image is converted into grayscale image
- The image is filtered to remove noise and artefacts, and the image is enhanced
- Threshold is computed, and segmentation is performed (watershed)
- Morphological operations are evaluated/calculated
- The output as the segmented tumour image is obtained

These processes are explained further,

Grayscale Image: Normally, MRI images are half-tone images with the colour intensity being either completely black or white, there is no other shade present. The grayscale images contain shades of gray ranging in different intensities.The darkest colour is black, absorption of all wavelengths and the lightest colour is white, total reflection of all wavelengths [7].

Histogram Equalization, Filtering and Edge Detection: In the pre-processing step, edge detection method is used on grayscale images to detect the exact edges and parameter of the tumour [8]. The boundary between two different gray levels of two objects is the 'edge', detection of the edges in the image is aimed at finding the points where the difference between the intensities around the point is large enough to term it as an abnormality in the image. Histogram method is used to provide clarity and enhancement in the image by increasing or decreasing the contrast in the image to see the smaller details in the image [9]. When the histogram method is used to increase the contract the resolution and quality of the image depletes due to increase in noise [10] To obtain a clear contrast, noise free and good quality image, we should use filters on the MRI images. We use high pass filters on the image to increase the contrast, this is done by removing or minimising the low frequency data and retaining only the high

frequency data. This results in high quality contrast image. The high pass filter kernel has one positive or higher value in the centre of the matrix, all the other values being negative or lower than the centre value. The median filter is most effective as it increases the contrast, removes noise and preserves the edges in the image. The median filter moves one by one on each value in the image and replaces the value by median value of the neighbouring pixel values [11].

Segmentation and Post-Processing: Segmentation of the image can be done by various methods like thresholding, which is the simplest method, where a threshold value is selected to convert grayscale image into binary image [12]. Segmentation process involves separation of the objects in an image which is used for analysis [13]. It is used to locate a structure, its boundary and size. Another segmentation technique called watershed technique is used by computing different watershed lines to detect boundaries in the image [14].The watershed algorithm works on a gray scale image. During flooding of two adjacent catchment basins, a watershed line between the two basins is formed just before the overflowing. The basins, hence emerge along the edges where the watershed lines are formed. This leads to highly segmented image with a lot of noise. The image is then required to be pre-processed, or the regions which are similar should be merged. Watershed segmentation can be performed by:

- By choosing seed points where the flooding should start, different labels are given to each seed point
- The neighbouring pixels of the seed point are categorised based on their gray level intensities
- The pixels upon categorisation are put in priority queue to allow flooding, the highest priority pixel is extracted from the queue on by one and new pixels are added in the queue
- This process is repeated until no more pixels can be added and the left out pixels form the watershed lines [14].

Morphological Operations:

Morphological operations are non-linear operations which are decided based on the shape and morphology of the structure in the image. These operations use the data about the relative position and ordering of the pixels and not their numeric data, mostly during binary image processing [15]. A small image is probed with a particular shape which is used as the structuring element, it is made to move through the entire image to check if it fits or matches any part of the image with similar neighbours or it intersects the neighbouring pixels in the image. If the test is successful at any point in the input image, a new binary image is created which has non-zero values [16].

SEGMENTED IMAGES

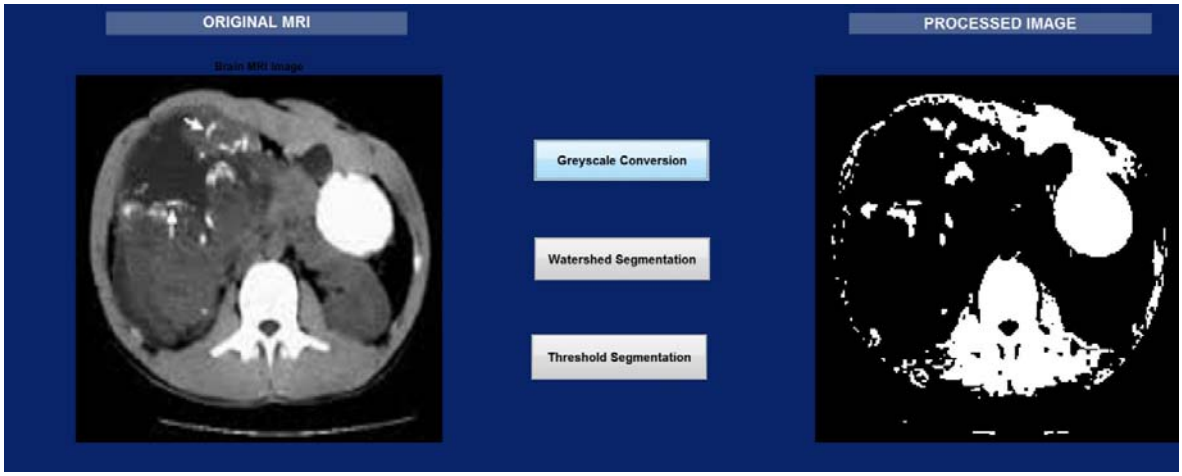

Fig 3. GreyScale Conversion

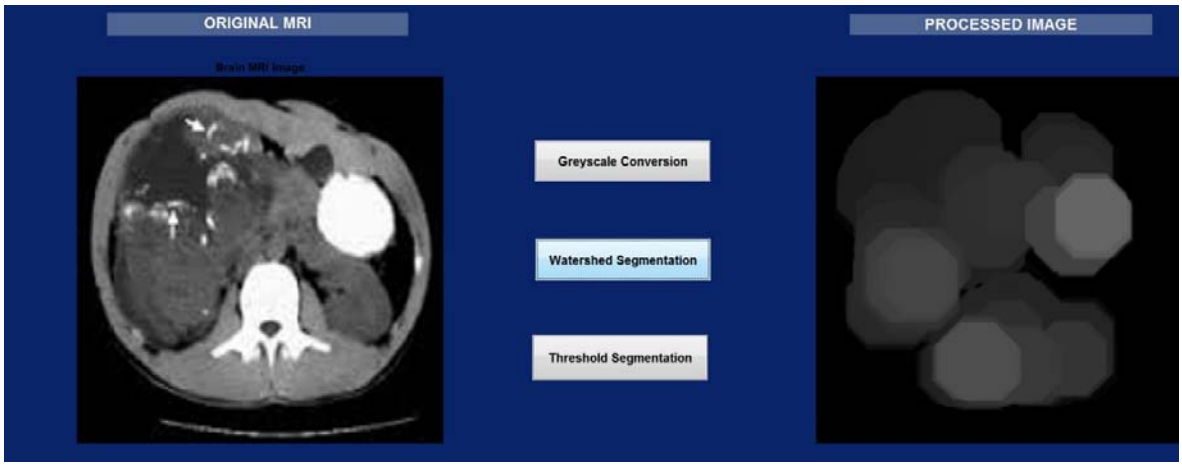

Fig 4. Water Segmentation

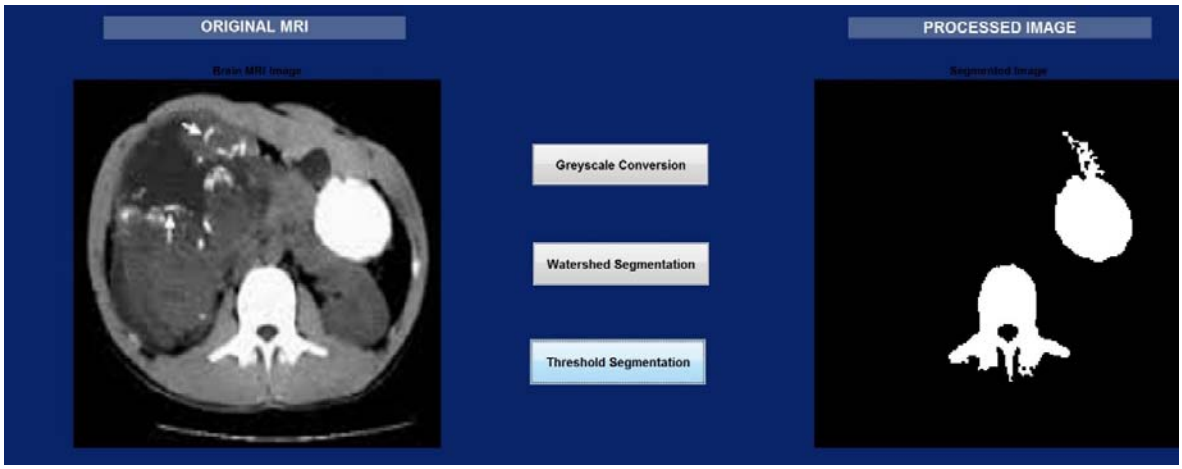

Fig 5. Threshold segmentation of the tumours

CONCLUSION

Grey scale images of brain that contain tumour/s are the input to the proposed algorithm. The image is processed through various stages of morphological operations like filtering, contrast adjustment, erosion, dilation etc. through MATLAB programming. Hence, the tumour is outlined in the original image and clearly demarcated. A GUI is also developed which enables the above application with a user-friendly interface.

FUTURE SCOPE

Use of correct combination of techniques and algorithms can help in achieving a better, noise free, well defined boundaries of the tumour in the image. In Future, the project can be extended to classify different types of tumours based on structure, shape, size and malignancy level by other techniques available.

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