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A Comprehensive Review of Various Medical Image Processing Techniques for MRI Images.

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Abstract—Image processing is one of the most challenging and growing research area these days. This paper gives the review of two image processing techniques that are watershed segmentation and k-means clustering segmentation. These techniques helps in detecting the brain tumour in MRI images. Basically MRI images are visually examined by the physician for detection of brain tumour but this method does not provides accurate results [1]. So these image processing techniques are helpful for the early detection and diagnosis of brain tumour.

Keywords—Medical Image Processing, Magnetic resonance imaging (MRI), Watershed segmentation, k-means clustering segmentation, Brain tumour.

I. INTRODUCTION

A. *MEDICAL IMAGE PROCESSING:*

Medical imaging is the technique and process used to create images of the human body for clinical purposes or we can say that it is a medical procedures seeking to reveal, diagnose, or examine diseases. Although imaging of removed organs and tissues can be performed for medical reasons, such procedures are not usually referred to as medical imaging, but rather are a part of pathology.It is part of biological imaging and incorporates Radiology, Magnetic Resonance Imaging, Nuclear medicine, medical Ultrasonography or Ultrasound, Endoscopy, Elastography, Tactile Imaging, Thermography and medical photography. Medical imaging allows doctors to see within the human body so that they can diagnose and treat diseases. Doctors can see a broken bone or changes within internal organs and blood vessels. They can even explore the whole human body [2].

B. *MAGNETIC RESONANCE IMAGING:*

Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique used to produce high quality images of the parts contained in the human body. MRI imaging is often used when treating brain tumours, ankle, and foot. From these high-resolution images, we can derive detailed anatomical information to examine human brain development and discover abnormalities [3]. Normally the anatomy of the Brain can be viewed by the MRI scan or CT scan. The MRI scan is more comfortable than CT scan for diagnosis. It does not affect the human body. Because it doesn't use any radiation. It is based on the magnetic field and radio waves. CT uses ionizing radiation but MRI uses strong magnetic field to align the nuclear magnetization then radio frequencies changes the alignment of the magnetization which can be detected by the scanner. That signal can be further processed to create the extra information of the body [4].

C. *BRAIN TUMOUR:*

Tumour is defined as the abnormal growth of the tissues.Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably, seemingly unchecked by the mechanisms that control normal cells. Brain tumors can be primary or metastatic, and either malignant or benign. A metastatic brain tumor is a cancer that has spread from elsewhere in the body to the brain [5].There are three common types of tumor[6]:

1) Benign
2) Pre Malignant
3) Malignant(cancer can only be malignant) [7].

1) Benign Tumour: A benign tumor is a tumor is the one that does not expand in an abrupt way; it doesn't affect its neighboring healthy tissues and also does not expand to non-adjacent tissues. Moles are the common example of benign tumors.
2) Pre-Malignant Tumour: Premalignant Tumor is a precancerous stage, considered as a disease, if not properly treated it may lead to cancer.

3) Malignant Tumour: Malignancy (mal- = "bad" and -ignis = "fire") is the type of tumor, that grows worse with the passage of time and ultimately results in the death of a person. Malignant is basically a medical term that describes a severe progressing disease. Malignant tumor is a term which is typically used for the description of cancer [4].

D. WATERSHED SEGMENTATION:

It is one of the best methods to group pixels of an image on the basis of their intensities. Pixels falling under similar intensities are grouped together. It is a good segmentation technique for dividing an image to separate a tumor from the image.Watershed is a mathematical morphological operating tool. Watershed is normally used for checking output rather than using as an input segmentation technique because it usually suffers from over segmentation and under segmentation [8].

For using watershed segmentation different methods are used. Two basic principle methods are given below: 1) the computed local minima of the image gradient are chosen as a marker. In this method an over segmentation occurs. After choosing marker region merging is done as a second step; 2) Watershed transformation using markers utilizes the specifically defined marker positions. These positions are either defined explicitly by a user or they can be determined automatically by using morphological tools [4].

E. K-MEANS CLUSTERING SEGMENTATION:

K-Means is the one of the unsupervised learning algorithm for clusters. Clustering the image is grouping the pixels according to the some characteristics. In the kmeans algorithm initially we have to define the number of clusters k. Then k-cluster center are chosen randomly. The distance between the each pixel to each cluster centers ar calculated. The distance may be of simple Euclidean function. Single pixel is compared to all cluster centers using the distance formula. The pixel is moved to particular cluster which has shortest distance among all. Then the centroid is re-estimated. Again each pixel is compared to all centroids. The process continuous until the center converges. [9]

Algorithm for k-means clustering [10]:

1) Give the no of cluster value as k.
2) Randomly choose the k cluster centers
3) Calculate mean or center of the cluster
4) Calculate the distance b/w each pixel to each cluster center
5) If the distance is near to the center then move to that cluster.
6) Otherwise move to next cluster.
7) Re-estimate the center.
8) Repeat the process until the center doesn't move.

II. DIFFERENT ALGORITHMS FOR MEDICAL IMAGE PROCESSING TECHNIQUES:

Now brain tumour in MRI Images can be detected by either using watershed segmentation or by using k-means clustering segmentation.Different algorithms are to be used for both these segmentation techniques.According to [3,4] algorithm for watershed segmentation is given below:

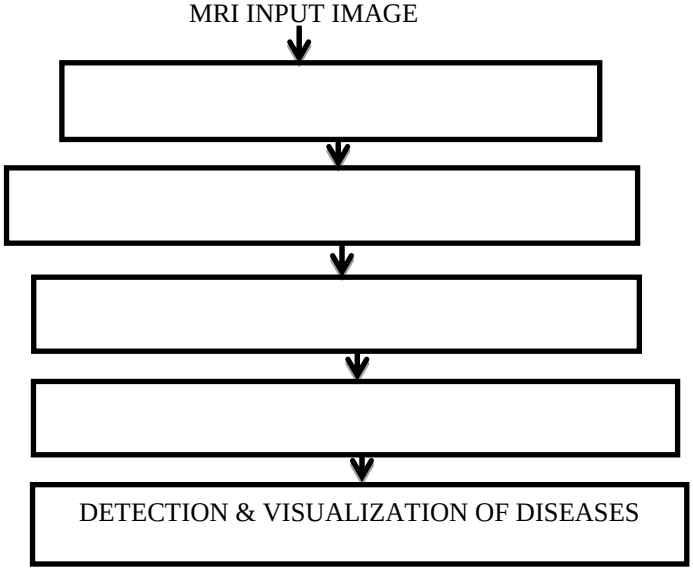
The algorithm has two stages, first is pre-processing of given MRI image and after that segmentation and then perform morphological operations. Steps of algorithm are as following:-

1) Give MRI image of brain as input.
2) Convert it to gray scale image.
3) Apply median filter to enhance the quality of image.
4) Compute threshold segmentation.
5) Compute watershed segmentation.
6) Compute morphological operation.
7) Finally output will be a tumour region.

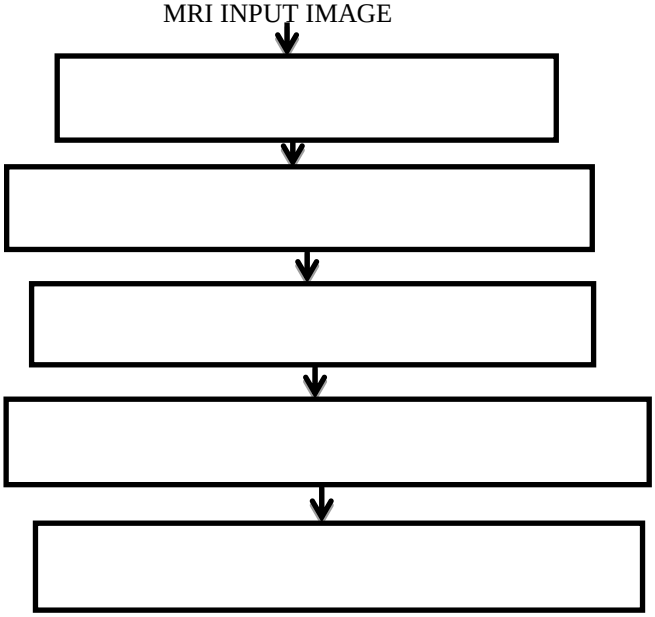
For k-means clustering segmentation, algorithm is given below [11]:The algorithm has two stages, first is pre-processing of given MRI image and after that segmentation and then perform morphological operations. Steps of algorithm are as following:-

1) Give MRI image of brain as input.
2) Convert it to gray scale image.
3) Apply median filter to enhance the quality of image.
4) Compute threshold segmentation.
5) Compute k-means clustering segmentation.
6) Compute morphological operation.
7) Finally output will be a tumour region.

III. BLOCK DIAGRAM FOR WATERSHED SEGMENTATION:



IV. BLOCK DIAGRAM FOR K-MEAMS CLUSTERING SEGMENTATION:



V. CONCLUSION:

Previous researches shows that brain tumours can be detected at an earlier stage using various medical image processing techniques. The medical image processing techniques which they used were watershed segmentation and k-means clustering segmentation. With the help of these techniques, brain tumours can be detected at an early stage and can be curable. For the detection purpose, real time patient data is taken for the analysis.

VI. Future work:

The stage of tumour is based on the area of the tumour. So, size of the tumour can be calculated by calculating the number of white pixels(digit 0) in binary image.

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