Modern Development of Image Detection on Brain Tumor: A Review

Pooja Sahu[1] Prof. Amit Ganguli[2]
[1]Research Scholar [2]Assistant Professor
[1,2]Department of Computer Science and Engineering
[1,2]SisTec, Bhopal, India

Abstract— Medical image processing is a research area with an inter-disciplinary character that has significantly developed in recent decades and it has a large application domain for unnecessary clinical problems. Brain tumor detection is one of the most challenging tasks. Using MRI image it is possible to detect brain tumor. The detection can be done by using various image detection techniques Magnetic resonance is commonly more responsive in detecting brain abnormalities during the early phase of disease and it is outstanding in early detection of cases of intellectual infarction, brain tumors, or infections are finding difficult task because of the variety of shapes, locations and image intensities.

Keywords: Magnetic resonance imaging (MRI), Computed Tomography (CT), Image Segmentation, Region of Interest (ROI)

I. Introduction

Magnetic Resonance Imaging (MRI) technique occupies a major arrangement in the region of diagnosing the organs of human body. The problem is particularly difficult in the context of brain tumors. Detecting the precise boundary of the region holding a standard brain tumor is a complex problem and must be addressed since it applies to many medical modalities and tumor types. Modern medical imaging systems are proficient of providing huge amounts of images, which requires in - depth examination. MR images are qualitatively and quantitatively examined by skilled based on their professional experience, but it is certainly limited by the human vision system, where human eye vision is classified to examine 8-bits of grey level. Magnetic resonance imaging (MRI), nuclear magnetic resonance imaging (NMRI), or magnetic resonance tomography (MRT) is a medical imaging technique working in radiology to study the anatomy and understanding of the organization in both health and disease. The procedure of division i.e. segmentation, is remunerated at most significance in the structure of a robust and efficient diagnosis scheme. Images Segmentation is achieved on the input images.

MRI has an extensive variety of applications in medical diagnosis and there is approximation to be over 25,000 scanners in utilize global [1]. MRI has a contact on diagnosis and dealing in many specialties even though the consequence on progressed health outcomes is undecided [2]. Since MRI does not use any ionizing radiation it's utilize is suggested in favorite to CT when each modality could give up the similar information. The brain is a complex organ that contains 50–100 billion neurons. It is made up of a large number of cells, and each cell has a specific function. Most of the cells that are generated in the body partition to form new cells for appropriate functioning of the human body. When new natural cells grow, aged or damaged cells die. Then, new cells take their place. Sometimes, new cells are generated when the body does not need them. Moreover, aged or damaged cells do not die as they should. The body produces extra cells that construct a lump of tissue called a tumor. A tumor inlaid in the brain region causes the sensitive functioning of the body to be malformed. It is very difficult and perilous to treat due to its location and spreading capability [3–5]. However, there are some problems, such as it taking a large amount of time, and segmentation of MR image by different experts may vary significantly. Brain tumors are primarily categorized into two types: benign and malignant. Benign tumors are those tumors which are non-cancerous, and malignant ones are those which contain cancerous cells [6]. The early detection and recognition of brain tumors is very crucial. Presently, computer-aided diagnosis (CAD) systems are usually used for systematic and specific detection of brain abnormalities [7]. Moreover, the result of tumor detection may vary under different circumstances by the same physician, and the brightness and contrast of the display screen can vary the segmentation results. For these reasons, the automatic detection of brain tumors becomes significant. Automatic detection of brain tumors can increase the probability of survival of a tumor. The combination of association function in to spatial data of input image reimburses the consequence of noise according to [8]. In the medical field, there is no standard method that can be constructed for brain-tumor detection. Several research works are attempting to detect brain tumors automatically with improved accuracy, exactness, and speed of computation by minimizing manual effort [9]. The detection of brain tumors means identifying not only the affected part of the brain but also to the tumor shape, size, boundary, and position. Different imaging technologies such as magnetic resonance image (MRI), computed tomography (CT), positron emission tomography (PET), etc. are used for imaging the brain. Most frequently, the anatomy of the brain tumor can be tested by MRI scan or CT scan. However, the CT scan contains radiation that is detrimental to human body, whereas MRI gives accurate visualization of the anatomical formation of tissues of the brain [10]. The MRI is a device that conducts a magnetic field and radio waves for generating detailed images of the organs and tissues. Processing of MR images are extremely complicated and constantly scrutinized by researchers to give pathologists an improved experience to diagnose the patients [11].

II. Theoretical Background

A brain tumor is defined as abnormal growth of cells within the brain or central spinal canal. Some tumors can be cancerous thus they need to be detected and cured in time. The exact cause of brain tumors is not clear and neither is exact set of symptoms defined, thus, people may be suffering from it without realizing the danger. Primary brain tumors can be either malignant (contain cancer cells) or benign (do not contain cancer cells) [12].

Brain tumor occurred when the cells were dividing and growing abnormally. It is appear to be a solid mass when it diagnosed with diagnostic medical imaging techniques. There are two types of brain tumor which is primary brain tumor and metastatic brain tumor. Primary brain tumor is the condition when the tumor is formed in the brain and tended to stay there while the metastatic brain tumor is the tumor that is formed elsewhere in the body and spread through the brain [13]. Magnetic resonance imaging of brain image computing has very augmented area of medicine by on condition that various unusual techniques to remove and visualize data from medical data, obtained using various acquisition modalities. More, events for detecting or measuring transforms in metabolism, blood flow, chemical composition, and absorption can be achieved nowadays due to functional imaging methods. Among the medical image modalities, Ultrasound (US), Computed Tomography (CT), Magnetic Resonance (MRI) and Positron Emission Tomography (PET) imaging have become of great concern in many research areas. All these anatomical and functional imaging modalities are of excessive importance in numerous domains of medicine, for ex., computer aided-diagnosis, pathology follow-up, treatment planning and therapy (surgery, radio-therapy, chemo-therapy etc.).

These efforts propose a novel method using morphological operators and expand an erosion process to recognize and remove the edge of a brain tumor. Using uncharacteristic images of a range of brain tumors this learning demonstrates that the proposed algorithm make available a robust technique in terms of correctness and computation time, construction it appropriate for real-time processing.

III. SEGMENTATION

The image segmentation [15] is the procedure of separating a digital image into various segments i.e. sets of pixels and it also known as super pixels. The aim of segmentation is to make simpler and/or transform the demonstration of an image into somewhat that is more significant and easier to examine. Image segmentation is characteristically used to position objects and boundaries i.e. lines, curves, etc. in images. More correctly image segmentation is the development of transferring a tag to every pixel in an image such that pixels with the similar tag distribute definite visual distinctiveness. In case of medical image segmentation the objective is to:

- Study anatomical arrangement.
- Recognize Region of Interest (ROI) i.e. locate tumor, lesion and other defect.
- Compute tissue volumes to calculate development of tumor i.e. also decrease in size of tumor with treatment.
- Facilitate in treatment preparation earlier to emission therapy; in emission dose computation.

Using segmentation in medical images is a very significant job for detecting the irregularity, study and following development of diseases and surgery preparation.

Tumor brain image is very significant job of segmentation and kind of explanations. First step is to high grade of brain tumor typically showing unbalanced and indistinct boundaries with discontinuities. Segmentation algorithms utilize the non-image capable part of the tumor should be hold. It is utilized to division of the brain tumor image into areas of related attribute. The precise segmentation of MRI image is tissue classes of dissimilar particularly gray substance and Cerebrospinal fluid and white matter. Then compute the Regions of Interest (ROIs) in an image by segmentation. The digital image processing has extended more number of segmentation techniques. Only four common techniques are: initial is amplitude thresholding, subsequent is texture segmentation and next subsequent is template matching and final is region-growing segmentation. These techniques utilized for detecting tumors, edema and necrotic tissues. These kinds of segmentation algorithms are utilized to separating the brain images into three categories. Various authors proposed several algorithms for segmentation [16]. Generally segmentation is utilized to separating the brain images into two kinds. (i) Unsupervised segmentation (ii) Supervised segmentation.

A. Unsupervised Segmentation:

Image segmentation is the task of dividing an image into homogeneous regions. This requires an objective determine that is used to describe homogeneity. Although unsupervised segmentation techniques that uses an anatomic idea evaluate would be chosen over supervised techniques in view of the fact that they keep away from the human inconsistency associated with manual training data is avoided they have thus been of inadequate applicability. Supervised classification involves both a training phase that uses labeled information to become skilled at a model that maps from characteristics to labels and a testing phase that is employed to allocate labels to unlabeled information based on the calculated characteristics. While many unsupervised move towards also use these 2 phases the use of labeled information in the training phase of supervised methods strengths the model to focus on making unfairness in the characteristic space that communicate to the aspiration semantic unfairness.

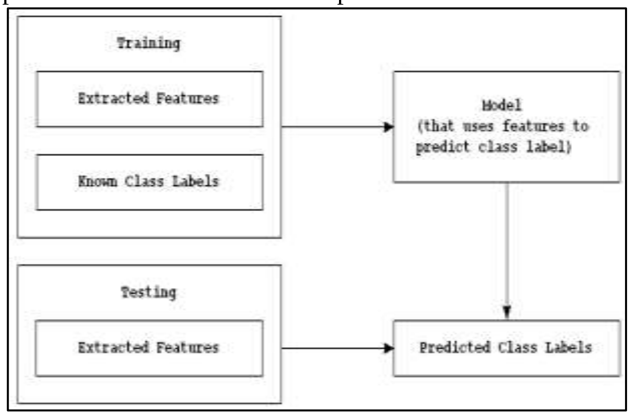

Fig. 2.1: general idea of supervised learning framework.

1) Unsupervised Segmentation with an Anatomic idea calculate:

Here [14] offered an unsupervised approach for the segmentation of attractive tumor pixels from T1-weighted post-contrast images. This scheme primary functional an intensity threshold to a manually preferred ROI and then used a region growing algorithm to enlarge the threshold areas up to the edges described by a Sobel edge detection filter.

The region growing effect was improved through iterations of dilation i.e. causing the described tumor area to grow, and erosion i.e. on the other hand causing the described tumor area to shrink. These two procedures transform the labels allocated to entity pixels by investigative the labels of neighboring pixels and are frequently referred to as morphological procedures.

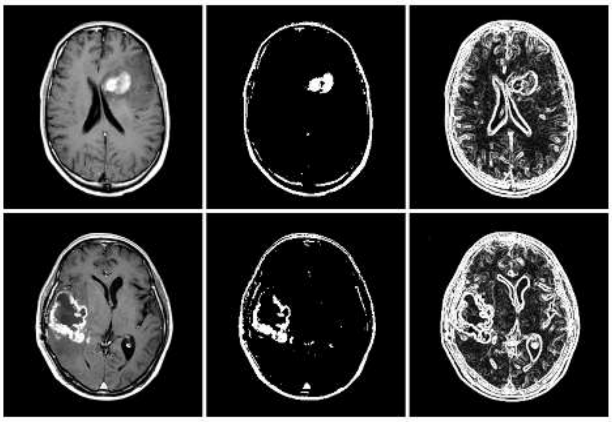

Fig. 2.2: Examples of low-level image processing in segmentation of attractive tumors.

2) Unsupervised Segmentation with an Image-Based idea calculate:

There has been significant research attempt intended for on the way to methods for unsupervised brain tumor segmentation in MR images that do not utilize an anatomic idea determine. Rather than dividing the image along anatomically significant features these techniques divide images into homogeneous areas using image-based characteristics such as intensities and/or textures and clustering is one process to do this. These techniques will not be enclosed in huge feature since there are major difficulties to this kind of approach. These comprise the realities that (1) the number of areas often requires to be pre-specified, (2) tumors can be separated into multiple areas, and (3) tumors may not have evidently distinct intensity or textural boundaries.

B. Supervised Segmentation:

Supervised techniques for image segmentation change from unsupervised techniques through the use of labeled training data used to repeatedly become skilled at a model for segmentation. The benefit that data-driven methods such as supervised techniques present is that appropriate patterns in the data are determined repeatedly rather than all the way through manual experimentation and perception. While many unsupervised methods also use these 2 phases the employ of labeled data in the training phase of supervised methods strengths the model to focus on making inequities in the characteristic space that communicate to the need semantic unfairness.

IV. LITERATURE SURVEY

The paper "Tumor Detection using Threshold operation in MRI Brain Images" by Natarajan P. et.al, [17] states that Primary brain tumors include any tumor that starts in the brain. Primary brain tumors can start from brain cells, the membranes around the brain (meninges), nerves, or glands. Tumors can directly destroy brain cells. They can also damage cells by producing inflammation, placing pressure on other parts of the brain, and increasing pressure within the skull. A metastatic brain tumor is a cancer that has spread from elsewhere in the body to the brain.

In the paper "A novel anatomical Structure segmentation method of CT head images" by X. Zang et.al [18] Histogram contains intensity value of 0-255. The zero value is the darkest part while the 255 was the white or the brightest side. Using the histogram analysis approached used the mixture Gaussian filter for the extracted part pixel intensity.

However, most of the technique used is more on MRI modality compared to CT images because it is higher resolutions. CT images of human body parts help medical doctors in diagnosing illness like brain tumor, colon cancer, lung cancer and so forth. However, it is quite difficult to obtain the important features in the images because it is limited by the image processing level and also doctor's experience. This is expressed in "Automatic Classification and segmentation of brain tumor in CT images using optimal dominant gray level run length texture features," by A. Padma and R. Sukanesh [19].

In this paper author presents a comparative study of three segmentation methods implemented for tumor detection. Here author has following are the outcomes of the work [20]: using methods include k-means clustering with watershed segmentation algorithm, optimized k-means clustering with genetic algorithm and optimized c- means clustering with genetic algorithm. Segmentation was achieved for all the proposed techniques tumor detection was done.

- The k- means clustering with watershed segmentation algorithm, optimized k –means clustering with genetic algorithm and optimized c- means clustering with genetic algorithm were the main techniques.
- A comparison was also made in terms of tumor region and search time.
- The c-means clustering after optimization was found improved than other techniques.
- The difficulty of over segmentation was also concentrated on.

As conventional k-means algorithm is responsive to the initial cluster centers. Genetic c-means and k-means clustering methods are used to detect tumor in MRI of brain images. At the end of development the tumor is removed from the MR image and its precise position and the shape are found out. An experimental result shows that genetic c-means not only remove the over-segmentation difficulty but also make available rapid and well-organized clustering effects.

Hemang J. Shah et al. studied various methods for detecting a tumor on MRI Images. In their research, they compared different image segmentation methods for evaluating their performance in the segmentation of a tumor. Those were Level Set Segmentation, K-means clustering, Difference in Strength Technique, and Watershed method. From their results, they concluded that all these methods have their own advantages and disadvantages. Level Set Segmentation requires the prior choice of the critical parameters such as the initial location of seed point, the appropriate propagation speed function and the degree of smoothness. The output image from K-means clustering has different intensity regions. An incorrect choice of threshold results in very weak accuracy in the segmented image when using Difference in Strength technique. Finally, Watershed suffers from the problem of over segmentation (a large number of segmented regions around each local minimum in the image) [21].

In this paper author present various methods for brain tumor segmentation for MRI images. These were seed-based regions growing, Level-set segmentation, Graph-based segmentation, Split and Merge-based segmentation; Edge based segmentation, and Morphological operations. In their research, they concluded that, in spite of the accessibility of a huge selection of very modern and using the most recent ideas and methods for brain MRI segmentation, it is still a tough task, and there is a need and wide scope for future research to improve the precision and accuracy of segmentation methods. Introducing new methods and combining different methods can be future schema for making improved brain segmentation methods [22]

Author S.M. Ali et al. has studied brain tumor extraction in MRI images using clustering and morphological operations techniques. In their research, MRI T2 weighted modality has been preprocessed by a bilateral filter to reduce the noise and maintain edges among the different tissues. They used the morphological operation (erosion and dilation) to smooth four different techniques: Gray level stretching and Sobel edge detection, the K-means clustering technique based on location and intensity, the Fuzzy C-means clustering, and an Adapted K- means technique. Their results showed that the four applied methods can effectively identify and extract the brain tumor. However, more work is required to improve the segmentation results, and this may be achieved by implementing certain supervised classification methods [23].

V. CONCLUSION

This paper presents an analysis of various proposed methods for segmenting an MRI image which relatively take lesser time than manual process to detect and extract the brain tumor and detecting the particular boundary of the region containing a distinguished brain tumor that is a complex difficulty and must be addressed since it applies to many medical modalities and tumor categories. The incomplete data problem is the main challenge that happens in the case of medical image reconstruction, in view of the fact that the information of the distribution of radioactivity inside the patient is not directly accessible, but only some measurements of a transformation of this information.

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