Brain Tumor Detection using Image Segmentation Techniques on MRI Images

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Abstract: A refine and absolute detection of the human disease can increase the level for the survival of well being. One of the major diseases can be determine as cancer or brain tumor. Different technique used for the tumor detection such as MRI (Medical Resonance Image), Ultrasound etc. It does not involve the X-ray so there are not side effects of MRI. Claustrophobic sensation can occur with MRI scanning because of the close machine with the suffocation and no movement while the scan can increase the time to complete the scanning process while movement can cause the errors or edge distortion. An MRI or magnetic resonance imaging is a radiology technique scan that uses radio waves and with the help of computer to produce images of different body parts. MRI scanner is a tube surrounded by a giant circular magnet. The patient is placed on a moveable bed that is inserted into the magnet. The magnet creates a strong magnetic field that aligns the protons of hydrogen atoms, which are then exposed to a beam of radio waves. A computer receives the information, which produces an image. MRI is the most accurate and safe method to detect the diseases by detecting the slight change in the body. For the best result various image segmentation techniques and the good edge detection algorithms are used for finding the edge to get the effective images for the examination purpose of medical images.

Keywords: Image processing, Segmentation, MRI (Magnetic Resonance Image), tumor

I. INTRODUCTION

The increment in the level of malignant cells causes the brain tumor. About 1M new cancer cases and 64th dead from cancer in US has been reported in 2019. As new advanced techniques are introduced each disease is detected quickly and lives are saved which lead to the decrease in death ratio by 2% in men and remain same with women (in cancer). Raymond damadian created the first MRI full body scanner, nicknamed as indomitable. During MRI test, signals are generated by hydrogen atom which is abundant in tissue, are placed in a strong magnetic field(1.5T) and excited by resonant magnetic (64MHzz frequency) excitation pulse. The above process performed on the body and a powerful antenna is used to pick information and sent to the computer. Brain is the highly important and sensitive organ of the body which control and manages the proper functioning like vision, movement, hearing, speaking, and sensations.

A tumor in the human body can cause abnormalities and can loss the control. Only early and appropriate detection the brain disease can solve the problem but it is a very difficult task to identify the problem. For this many automatic and advanced MRI of brain has been introduce and further researches are continue to provide the best processed and segmentation of brain image. Many new researches have been done on the MRI to get the better quality of image to find the tumor in brain and many other parts of body. To find the location and stage of the tumor is to get the good quality of brain image so that a neurosurgeon can analyze the image with correct information of tumor location.

II. LITERATURE SURVEY

This section of the paper represents the literature survey of the image processing, segmentation methods for different papers and uplifts the merits and drawback of the various journals.

Automatic and efficient MRI-US segmentation for improving intraoperative image fusion in image-guided neurosurgery[1] This paper title present the work on the image processing, registration(in real time) and segmentation. It uses the algorithm called B-mode US image for the efficient segmentation and registration process. The iUS (Intra-operative ultrasound) is for the real time intraoperative imaging. During iUS, slices were redesigned to a 3D volume for volumetric preMRI but original 2D slice were used for image segmentation. Different factors can be resolve occur in iUS like additional boundary values which is visible that can affect the quality factors.

PVR reconstruction for large area motion of fetal[2] This paper title present the work related the correction of fetal MRI of uterus as SVR(Slice-to-volume) is used.SVR is successful over the small motion area but not flexible to the whole body.
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PVR(Patch-to- volume) approach is used in these paper to overcome the disadvantage of SVR as PVR is successful in fetal MRI as well as brain and other body parts. This technique is implemented in two phases and provides the best results for the MRI.

Structurally-Sensitive multi-scale deep Neural network for low-dose CT denoising[3] this paper present the work related to CT denoising. This risk related the ionizing radiation is to be measured.

This paper discuss the various techniques introduced before to reduce the noise(during ionizing radiation) and specify their own technique or algorithm to provide good quality of image during low dose CT(LDCT).six different methods are provided. As it is performed as provided SMGAN-3D can given high level image quality from the existing denoising networks.

Optimizing MRI sequence and images for MRI-based stereotactic radiosurgery treatment planning[4] This paper title present the work done on MRI sequence and processing method on human brain scanning by the direct use of stereotactic radiosurgery(SRS) as it define the noisy or harmful impact cause on body during CT(as ionizing radiation). In this, it revolves around the comparison between CT and SRS technique used by MRI.

Effect of image enhancement on MRI brain image with neural networks[5] This paper title present the various technique that applied on MRI for the image processing that save the information details of patients. Each technique results are compared and results are used to train the neural network which is done by original images. In proposed work, IWNN(Image with Neural Network) it has two phase: as data preparation phase in which image input is collected and resized and in second phase the image from the first phase is prepared for the neural network. IPWNN(Image Processing with Neural Network) it gives the final parameters for the brain image with or without tumor.

Detection of Brain Tumor in MRI Images, using Combination of Fuzzy C-Means and SVM[6] This paper title present the work done on detection of brain tumor using data mining methods as it goes as follows combination of SVM(Support Vector Machine) and fuzzy C- means clustering. As fuzzy c-mean clustering for the image segmentation than GLRLM(Grey Level Run Length Matrix) used to extract the information from the image of brain whereas SVM is for the dividing the MRI images into different categories(or to classify the brain images) to analyze by the neurosurgeon to find that patient having tumor or not.

Computer Aided Medical Diagnosis Tool to Detect Normal/Abnormal Studies in Digital MR Brain Images[7] This paper title present the work done on the preparation of the tool to identify tumor in brain. The proposed system performs in following sequence and generates the effective results. The first step undergo as, Gabor filter to be used for the data training and testing. Secondly, the module named as Slim- tree metric structure where the indexing of trained data is done. Thirdly, train the SVM (Support vector metric). Moving on, dataset test is classified with trained SVM. Finally, classification is presented with a set of similar image retrieved.

Automatic Whole Brain Segmentation of the Developing Neonatal Brain[8] This paper title present the work done on the brain image segmentation of infants. As within 27 weeks of surveillance, infant brain grows and develops rapidly. This paper designs a algorithm to improve the image quality standards given by the existing systems. It combines two transformations of ALBERT’s with subject- specific tissue. The algorithm proposed is multi- structure Expectation Maximization (EM) based segmentation. It works as subdivision of the whole brain.

Noise-Resilient Edge Detection algorithm for Brain MRI Images[9] This paper title present the work done on the edge detection algorithm named as improved Canny edge detection algorithm and proposed the noise-resilient edge detection for the brain MRI images. The denosing is done via decomposition (laplacian of Gaussian is used).

A Novel Synthetic CT Generation method using Multitask Maximum Entropy Clustering[10] This paper title present the work done on the CT images, firstly the image segmentation to generate the CT image by providing the values and the proposed system MT-MEC algorithm on the brain image segmentation(first step) which produce good and better CT image and MT-MEC algorithm is accurate than FCM and MEC algorithm.

Table 1. Overview of Technologies

| Author          | Paper title                        | Proposed work                           | Merits                                      | Demerits                                      |
|-----------------|-----------------------------------|----------------------------------------|---------------------------------------------|-----------------------------------------------|
| J. Nitsch[1]    | Automatic & efficient MRI-US Segmentation | Intraoperative Ultrasound, B-mode US     | Reduce the denoising factors e.g. additional boundary values | Software is not relevant for the medical terminology(not fully integrated) |
| Amir Alansary[2] | PVR Reconstruction                  | SVR over PVR                            | Large field of non-rigid deforming structure | Additional quality analyses is to be performed(not proper mapping is done during 3D vol. to single vol. metric) |
| Chenyu You[3]   | Neural network for low-Dose CT denoising | Low-dose CT (LDCT) /RENI-               | Reduce the effect of ionizing radiation     | Suffer for potential risk of content detection |

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| Author                | Year | Paper title                        | Aims                                                                 | Sample | Comments                                                                 |
|----------------------|------|------------------------------------|----------------------------------------------------------------------|--------|-------------------------------------------------------------------------|
| J. Nitsch[1]         | 2019 | Automatic & efficient MRI-US Segmentation | Reduce the initial mean Target Registration Error                   | 11     | Reduce the computation time at the time of registration from 40.53s to 18.38s. That increase the robustness, accuracy and speed of registration process |
| Amir Alansary[2]     | 2017 | PVR Reconstruction                 | To evaluate motion errors like the distance error for selected anatomical landmarks in fetal head (non-rigid registration to a motion-free ground truth image) | 1      | Compare the computational performance over runtime results shows that multiscale superpixels shows better performance than PVR variants but both experiments evaluate local deformation which introduce error |
| Author(s) | Year | Title | Method | Result/Impact |
|----------|------|-------|--------|--------------|
| Chenyu You[3] | 2018 | Neural network for low-Dose CT denoising | Introduce the structurally sensitive multi-scale to improve the image quality of LDCT | Training the dataset different results was compared which meet the HVS requirements that contain the structural details so these method suffer form potential risk of content distortion |
| Somayeh Taghizadeh [4] | 2018 | Optimizing MRI based on SRS | Work on MRI sequences and processing method for the image generation for direct use in SRS | SRS treatment planning system which is not correct for the MR image distortion(correct can be done) for the correction visual checking is done but not provide enough information. So two methods are proposed. |
| Kamil Dimililer[5] | 2016 | Enhancement MRI brain images with neural network | Divided in two parts (a)IWNN nad (b)IPWNN | The proposed system is robust image processing system that can detect the any abnormalities in any brain region at small patches |
| Parveen[6] | 2015 | Detection of MRI images, combination of fuzzy C-means & SVM | Data mining methods for the classification of the MR images | Fuzzy c-means is used for segmentation and classification of MRI. A hybrid methodology of support vector and fuzzy c-means clustering give accurate results |
| Juan Gutierrez[7] | 2014 | Medical diagnosis tool to detect problem in MR brain Images | To give the content-based image retrieval system this system work in two phases | This work is done to find the normality/abnormality detection component for the radiologist |
| Antonios Makropoulos [8] | 2014 | Brain MRI segmentation of infants | Assist the brain development of infants. Work for the accuracy intensity-based segmentation (50 brain regions) | Improve the EM algorithm used for brain segmentation. In this, over 24 weeks the infant is watched to evaluate the result |
| Ali Almuntashri[9] | 2009 | Noise-resilient edge detection algo | A improved edge detection algo based with canny to reduce the noise over edges | The improved canned algorithm shows the improved results for the better edge detection |
| Jiang[10] | 2019 | Synthetic CT generation method using Multitask max Entropy clustering | MT-MEC algorithm introduce for the image segmentation with effective results | values of the three evaluation indicators of the MT-MEC algorithm is better than the FCM and MEC algorithms with less complex derivative. |

### IV. CHALLENGES

1. MRI scanner make noise which is low to high approx level of sound is 12dBA. Even the claustrophobia patient can feel uncomfortable rather than open MRI machine but the body have to go through.
2. Patient can feel the nerve stimulation like twitching which can get the artifacts while generating results.
3. The other factor is time taken during scanning (20-90 min)utes) and the cost of the MRI.
4. MRI the image can have severe distortions if screws, plates or artificial joints are present. So, medical history of patient is very important aspect.

### V. CONCLUSION

In the concern, for the accuracy of image segmentation is the most challenging area in image processing. In this paper, the study of several techniques is reviewed in the concern to form accurate results for the brain MRI. A detailed study is done in this literature survey and provides the sample for each research paper which is written in it. From the study the further research is done to increase the effectiveness of the image quality using machine learning techniques.
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