Review on MRI Brain Tumor Segmentation Approaches
K. Ganesamurthy and Dr. P. Vijayakumar

Abstract--- Brain tumor segmentation is a significant area in medical applications. Early on analysis of brain tumors plays a significant part in increasing handling potential and improves the survival rate of the patients. Segmentation methods based on the manual of the brain tumors designed for cancer analysis, from huge number of MRI images created in clinical routine, is a complicated and time consumption task. There is a required designed for automatic brain tumor image segmentation. Presently amount of conventional methods are used for MRI-based brain tumor image segmentation. In this review paper, many segmentation techniques have been introduced such as Dual-force Convolutional Neural Networks (CNNs), kernel sparse coding, Local Independent Projection-based Classification (LIPC), Ensemble based Support Vector Machine (SVM), K means Integrated with Fuzzy C means (KIFCM), Global threshold segmentation and Rough-Fuzzy C-Means (RFCM). These methods are used and studied for segmentation with their merits and demerits.

Keywords--- Brain Tumor, Rough-Fuzzy C-Means (RFCM), Manual segmentation and Magnetic Resonance Imaging (MRI).

I. INTRODUCTION

The tumor is an irregular development of cells in the body. It is measured as a vital illness as it influences the life of the human. On the other hand, early discovery of the tumour is extremely significant toward accumulate the existence of people. The tumour occurs in a variety of element of the body in which the entirety scheme is distorted, when it is in the brain. Brain tumour is individual of the major cause for death. Most important brain tumor produce inside the brain and is added categorized into benign and malignant [1-3]. Benign is recoverable and this category of tumor usually doesn’t increased toward further brain cells. Typically benign tumors are noncancerous. Malignant tumor category, on the other hand, is further serious than benign, and might direct toward cancer. It develops extremely rapidly and might influence further tissues of the brain. The early tumour detection of brain tumor assists on the way to improve the natural life of the patient. It is quite issue since of varied form, dimension, position and emergence of tumor in brain. It is difficult in start step since it can’t discover the precise dimension of tumor. Be that as it may, when it gets recognized the brain tumor it provides for beginning the correct treatment and it might be reparable. In this way, the medications rely upon tumor like; chemotherapy, radiotherapy and medical procedure [4].

Varied brain imaging technologies are used in order to identify brain tumor. These technologies give valuable data to doctors and researchers regarding the usual and unusual tissues within the brain. Multimodal imaging strategies used to analyze any variation within the brain and give astounding outcomes. Alongside the development of medical imaging, imaging modalities assume a significant area in the assessment of patients with brain tumors and have an important influence on patient consideration. These methods are the way toward coordinating images from same or distinctive imaging modalities to expand the nature of the image and reducing uncertainty and decrease excess of data in the images.

The Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are essentially used for anatomical structure visualization [5]. Metabolic and physiological processes are experimental by Positron Emission Tomography (PET). PET assists in order to give more detailed data. So researchers are focusing in order to integrate PET by CT and MRI imaging modularity to assist in analysis and accomplishment. Because the anatomical construction of the beginning is straightforwardly obtained from MRI, PET by means of restricted spatial resolution integrated by MRI gives improved data for recognition of the brain tumour. CT imaging system suffered from imprecise corresponding superposition beginning diverse images in use at diverse time. At this time, CT and PET were integrated in distinct scanner with the purpose of assist toward remove the above issue of CT. On the other hand, MRI is mostly used for tumour analysis designed for the subsequent merits:

1. Gives high-quality soft tissue contrast.
2. Produces no harmful energy.
3. Gives additional matching data toward PET by means of calculating physiological and metabolic parameters. Bimodal imaging is additional possible in PET/MRI related toward PET/CT. The major characteristic of PET/MRI is the concurrent size, which gives corresponding data of two modularizes.

The MRI-Technique is the majority successful designed for brain tumor recognition. MRI related brain tumor segmentation researches are focusing more concentration in current years appropriate toward non-invasive imaging and high-quality soft tissue compare of MRI images. Segmentation of tumor on brain is one of the forceful undertakings toward concentrate the properties of tumor in restorative activity improvement. It is the process of splitting an image into many

K. Ganesamurthy, M.C.A., Research Scholar, Department of Computer Applications, Sri Jayendra Saraswathy Maha Vidyalaya College of Arts and Science, Coimbatore, India.

Dr. P. Vijayakumar M.Sc., M.Phil., Ph.D., Head of the Department, Department of Computer Applications, Sri Jayendra Saraswathy Maha Vidyalaya College of Arts and Science, Coimbatore, India.

DOI:10.9756/IJIAP.9035
regions; such with the purpose of the pixels in the area have related properties. In the exact instance of MRI brain image, division of different tumor tissues from normal tissues is named as segmentation strategy. In helpful life, division of brain tumor is finished physically. The manual division of tumor needs more calculation time and may produce the erroneous outcomes. All together toward help specialists intended for examination and the executives of tumor and toward help inspector intended for studying the brain activities, the investigation in programmed segmentation techniques for brain tumor are centering more hugeness [6-8]. At present, division is troublesome issue for the sporadic shape and type of the brain tumor. Therefore medical area requires presenting another computer based segmentation by means of number of chosen characteristics similar to minimum user interaction, rapid computation and enhanced segmentation outcomes.

II. LITERATURE SURVEY

Zang et al (2011) designed a kernel feature selection approach so as to consolidate multi multi-spectral MRI images for brain tumor division by methods for the lesser time. Support Vector Machine (SVM) arrangement is proposed in this work with ideal choice of the features as a kernel space. According to the recognition, proposed work is utilized to analyze the brain tumor improvement, which incorporates of the resulting steps: (1) Towards concentrate the brain tumor and pick significant features from the primary MRI trial of the patients; (2) Toward naturally segment the tumor in new data by SVM; (3) Toward refines the tumor form by region growing method. The SVM framework has been investigated genuine patient image by methods for satisfying outcomes [9].

Usman Akram and Anam Usman (2011) proposed an algorithm for automatic MR brain tumor analytic system. The system includes of three steps toward identify and segment a brain tumor. In the first step, MR image of brain is collected and preprocessing is completed toward eliminate the noise and toward file the image. In the second step, global threshold segmentation is proposed on the sharpened image toward subdivision of brain tumor. In the third step, the segmented image is post processed via morphological functions and tumor masking in order toward eliminate the false segmented pixels. This system is invariant in terms of size, shape and strength of brain tumor. Results demonstrate that the proposed technique precisely finds and segments the brain tumor in MR images [10].

Demirhan and Guler (2011), to obtain sub images with the purpose of comprise multi resolution data; Stationary Wavelet Transform (SWT) is carryout. Spatial filtering scheme is then connected to eliminate factual highlights of sub images. A multidimensional element vector is framed by consolidating SWT coefficients and their accurate features. This vector is utilized as contribution to the Self-Organizing Map (SOM). Eventually, Learning Vector Quantization (LVQ) is connected toward tune the outcome. The proposed strategy is mixture, exact, quick, and powerful [11].

Huang et al (2014) introduced a tumor segmentation approach which depends on Local Independence Projection-based Classification (LIPC). It includes of four stages, i.e., preprocessing, feature extraction, tumor division utilizing the LIPC strategy, and postprocessing. Besides, LIPC includes the information distribution of various types by learning a softmax regression algorithm, which can further increase segmentation performance. The normal bones likeness of the proposed technique for dividing total tumor, tumor center, and difference improving tumor on genuine patient data are 0.84, 0.685, and 0.585, separately [12].

Aina et al. (2014) introduced a multi-stage system for tumor detection of brain tumors. There are two phases such as specific, tumor analysis and tumor area extraction is utilized. In tumor analysis, texture features are mined from the noise removed MR images. Ensemble Support Vector Machine (SVM) approach is exploited to sort out tumors. In texture extraction phase, skull migration, brain area extraction and brain tumor extraction are done to free the cerebrum tumor. The issue of standard fuzzy clustering is with the purpose it does exclude any spatial data for separation [13].

Abdel-Maksouda et al., (2015) introduced a K means clustering and Fuzzy C Means (FCM) namely KIFCM based brain tumour segmentation. K means clustering computes the tumour area by smallest execution time. Other than in the box of malignant tumour this algorithm gives inappropriate segmentation result. FCM is other type of segmentation algorithm for MRI brain tumour. Other than this method is the majority appropriate for noise removed images. However it requires extended iterative time for brain tumour segmentation. The proposed method makes use of the features of above two algorithms to solves the issue of the longer running time and increase the results of segmentation [14].

Cheng et al (2015) proposed improved results of brain tumor segmentation by tumor region growth and separation. Primary, the increased tumor area by image dilation is utilized as the ROI as alternative of unique tumor area since tumor nearby tissues be able to moreover present significant indication designed for tumor categories. Subsequent, the augmented tumor area is divided addicted to gradually finer ring-form subareas. The proposed system assess the competence on a huge image dataset by means of three feature extraction methods, specifically, intensity histogram, Gray Level Co-Occurrence Matrix (GLCM), and Bag-Of-Words (BoW) model. Experimental results show with the purpose of the considered technique is possible and successful for the detection of brain tumors in T1-weighted CE-MRI [15].

Bal et al (2018) presented a novel algorithm for brain tumor segmentation with the help of Rough-Fuzzy C-Means (RFCM) and shape based characteristics. In RFCM, covering segment is proficiently take care of by fluffy participation and implausibility in the datasets is overcome by lower and upper bound of the rough set. Fuzzy boundary and crisp lower estimation in RFCM takes an interest of division on brain images. Beginning centroids picked are a most significant in C-means techniques. Current work built up another strategy for begin centroids determination with diminished execution time of RFCM as option of arbitrary beginning centroids. A patch based K-implies grouping is additionally presented for skull stripping and it is considered as a preprocessing
calculation. It was implemented on MRI standard datasets. An outcome infers that the proposed RFCM approach has acquired better outcomes relying upon arithmetical volume measurements [16].

Chen et al (2019) created as Dual-force Convolutional Neural Networks (CNNs) for exact brain tumour segmentation. The CNNs incorporate of four stages. First, the designed system expands the established DeepMedic scheme toward Multi-Level DeepMedic in the direction of make use of multi-level data for more exact segmentation. Second, dual-force training method is created toward assistance the estimation of staggered highlights gained from deep models. It is a typical training method and capable to be valuable to various present models, e.g., DeepMedic and U-Net. Third, dispersion based loss function is acquainted as an assistant classifier with help the high state layers of deep models toward learns extra hypothetical information. At last, novel Multi-Layer Perceptron (MLP)- based post-preparing approach is proposed to process the segmentation outcomes of deep models [17].

Tong et al (2019) proposed novel method for MRI brain tumor segmentation relying upon surface features and kernel sparse coding. Initially, the MRIs are pre-handled toward reduction of noise, improve brightness and precise the quality non-consistency. Thusly sparse coding is applied on the primary order and second order factual component vector extricated from one of a kind MRIs which are a patch of $3 \times 3$ around the voxel. The kernel dictionary learning is used toward concentrate the non-linear features toward fabricate two adaptive dictionaries presented for healthy and pathologically tissues correspondingly. A kernel-clustering approach is done dependent on lexicon learning is presented toward code the voxels, and in this manner the direct separation strategy is used toward classify the tumor pixels. Finally, the flood-fill activity is used to expand the segmentation superiority. Results demonstrate that the designed method has improved capacity and higher outcomes with diminished time calculation [18].

III. COMPARATIVE ANALYSIS

| S.NO | Author details | Title | Merits | Demerits |
|------|----------------|-------|--------|----------|
| 1.   | Zang et al (2011) | Kernel feature selection to fuse multi-spectral MRI images for brain tumor segmentation | Acceptable accuracy for tumour detection | It has issue with segmentation errors. |
| 2.   | Usman Akram and Anam Usman (2011) | Computer Aided System for Brain Tumor Detection and Segmentation | It achieves better results for segmenting and extracting the brain tumor from MR images. | Need to improve the accuracy with less time |
| 3.   | Demirhan and Güler (2011) | Combining stationary wavelet transform and self-organizing maps for brain MR image segmentation | Various schemes are merged to segment brain MRI image. | The accuracy is minimum for segmenting white matter in brain MRI image. |
| 4.   | Huang et al (2014) | Brain Tumor Segmentation Based on Local Independent Projection-based Classification | Reduce computation cost, improves the robustness | Not applicable for synthetic data group |
| 5.   | Aina et al. (2014) | Fuzzy anisotropic diffusion based segmentation and texture based ensemble classification of | Benefits of various schemes are integrated to attain accurate outcome | Huge computational complexity in integrating various schemes |
IV. CONCLUSION AND FUTURE WORK

The MRI segmentation strategy is a significant suggestive device for the prediction of tumors from brain images. In this paper exhibited the study of various brain tumor segmentation strategies up until now, too their merits and demerits are studied. It is reasoned with the purpose of the segmentation strategies giving the segmented consequence of the MR image to distinguish the tumors. From this examination, Rough-fuzzy C-means based Brain Tumor Segmentation approach accomplishes better recognition compared to different techniques. The computer-aided strategies and their examinations have decreased the workload at hand of specialists and accomplish improved diagnostic exactness. In future work, different strategies are proposed to accomplish increasingly precise, proficient just as quicker for early identification and characterization of brain tumors.

REFERENCES

[1] G. Nelly, E. Montseny and P. Sobrevilla, “State of the art survey on MRI brain tumor segmentation”, Magnetic resonance imaging, Elsevier, Vol. 31, No. 8, Pp. 1426-1438, 2013.
[2] S.U. Aswathy, G. Glen Deva Dhas and S.S. Kumar, “A survey on detection of brain tumor from MRI brain images”, In IEEE International Conference on, Control, Instrumentation, Communication and Computational Technologies (ICCICCT), Pp. 871-877, 2014.
[3] A. Asra, E. Khan and M.M. Sufyan Beg, “Improved Edge Detection Algorithm for Brain Tumor Segmentation”, Procedia Computer Science, Vol. 58, Pp. 430-437, 2015.
[4] S.D. Olabarriaga and A.W. Smeulders, “Interaction in the segmentation of medical images: A survey”, Medical image analysis, Vol. 5, No. 2, Pp. 127-142, 2001.
[5] S. Bauer, R. Wiest, L.P. Nolte and M. Reyes, “A survey of MRI-based medical image analysis for brain tumor studies”, Physics in Medicine & Biology, Vol. 58, No. 13, 2013.
[6] S. Bauer, C. Seiler, T. Bardyn, P. Buechler and M. Reyes, “Atlas-based segmentation of brain tumor images using a Markov random field-based tumor growth model and non-rigid registration”, In Annual International Conference of the IEEE Engineering in Medicine and Biology, Pp. 4080-4083, 2010.
[7] A. İzm, C. Direkoğlu and M. Şah, “Review of MRI-based brain tumor image segmentation using deep learning methods”, Procedia Computer Science, Vol. 102, Pp. 317-324, 2016.
[8] T. Węgliński and A. Fabijanśka, “Brain tumor segmentation from MRI data sets using region growing approach”, In Perspective Technologies and Methods in MEMS Design, Pp. 185-188, 2011.
[9] N. Zhang, S. Ruan, S. Lebonvallet, Q. Liao and Y. Zhu, “Kernel feature selection to fuse multi-spectral MRI images for brain tumor segmentation”, Computer Vision and Image Understanding, Vol. 115, No. 2, Pp. 256-269, 2011.
[10] M.U. Akram and A. Usman, “Computer aided system for brain tumor detection and segmentation”, In International Conference on Computer Networks and Information Technology, Pp. 299-302, 2011.
[11] A. Demirhan and I. Güler, “Combining stationary wavelet transform and self-organizing maps for brain MR image segmentation”, Engineering Applications of Artificial Intelligence, Vol. 24, No. 2, Pp. 358-367, 2011.
[12] M. Huang, W. Yang, Y. Wu, J. Jiang, W. Chen and Q. Feng, “Brain Tumor Segmentation Based on Local Independent Projection-based Classification”, IEEE Transactions on Biomedical Engineering, Vol. 61, No. 10, Pp. 2633-2645, 2014.
[13] Q. Ain, M.A. Jaffar and T.S. Choi, “Fuzzy anisotropic diffusion based segmentation and texture based ensemble classification of brain tumor”, Applied soft computing, Vol. 21, Pp. 330-340, 2014.
[14] E. Abdel-Maksoud, M. Elmogy and R. Al-Awadi, “Brain tumor segmentation based on a hybrid clustering technique”, Egyptian Informatics Journal, Vol. 16, No. 1, Pp. 71-81, 2015.

[15] J. Cheng, W. Huang, S. Cao, R. Yang, W. Yang, Z. Yun and Q. Feng, “Enhanced performance of brain tumor classification via tumor region augmentation and partition”, PloS one, Vol. 10, No. 10, 2014.

[16] S. Chen, C. Ding and M. Liu, “Dual-force convolutional neural networks for accurate brain tumor segmentation”, Pattern Recognition, Vol. 88, Pp. 90-100, 2019.

[17] J. Tong, Y. Zhao, P. Zhang, L. Chen and L. Jiang, “MRI brain tumor segmentation based on texture features and kernel sparse coding”, Biomedical Signal Processing and Control, Vol. 47, Pp. 387-392, 2019.

[18] A. Bal, M. Banerjee, A. Chakrabarti and P. Sharma, “MRI brain tumor segmentation and analysis using rough-fuzzy C-Means and shape based properties”, Journal of King Saud University-Computer and Information Sciences, 2018.