Automated Detection Techniques of Brain Tumour: Survey

Deepak Khosla[1], Ms. Tanisha [2]
[1]*M. Tech (Scholar),* [2]*Assistant Professor*
Department of Computer Science and Engineering, Chandigarh Engineering College, Landran (Punjab)

Abstract - Biomedical Image Processing is a growing and demanding field. It comprises of many different types of imaging methods likes CT scans, X-Ray and MRI. These techniques allow us to identify even the smallest abnormalities in the human body. Brain tumor detection and segmentation is one of the most challenging and time consuming task in medical image processing. MRI (Magnetic Resonance Imaging) is a medical technique, mainly used by the radiologist for visualization of internal structure of the human body without any surgery. MRI supplies the statistics about soft tissues of human body, which helps to detect and diagnose brain tumour. Accurate segmentation of MRI image is important for the diagnosis of brain tumor by computer aided clinical tool. Once the MR images of brain are accurately segmented, tumour is classified as malignant and benign, which is a difficult task due to complexity and variation in tumor tissue characteristics like its shape, size, gray level intensities and location. Generally, brain tumor segmentation methods can divided into two main categories, spatial continuous and spatial discrete methods. Several methods, techniques, related advantage and weakness will be described and discussed. The evaluation measures are mentioned and the qualities of different method focus on the methods that were applied on the standard data sets. The efficient and stably brain tumor segmentation is still a challenging task for the unpredictable appearance and shape of the brain tumor.

Keywords - Biomedical Image Processing, Magnetic Resonance Imaging, Brain tumour detection and several methods.

I. INTRODUCTION

Detection of brain tumour is very common fatality in current scenario of health care society. To extract the abnormal tumour portion in brain, image segmentation is generally used. An irregular tissues where cells grows and multiply immensely, visibly unregulated by technique that control cells is a Brain Tumour. Several techniques have been developed for detection of tumor in brain. A tumor is abnormal tissue that grows by uncontrolled cell division. Normal cells replace old or damaged ones. Due to unknown reasons, tumour cells reproduce uncontrollably. Brain tumors are named after the cell type from which they grow can be primary or secondary. Depending upon the stage of tumour and age and health of the patient, medical treatment could be varied, i.e. concerned regarding relieving symptoms or curative [1].

Image segmentation is one of the most important and active research area in the medical imaging domain. It can be defined as the delineation of one or several structures of interest within the image. Automated methods are sought in order to avoid the time consuming burden of manually contouring the structures. The problem is particularly difficult in the context of brain tumors. Indeed, most tumors have heterogeneous appearances and their intensity range overlap with the healthy tissues'. The presence of a necrotic core is frequent (especially for glioblastomas, but it also occurs for DLGGs) resulting on a strong contrast with the "active" tumor. Prior information regarding the shape of the tumor cannot be used as they have variable sizes and shapes. DLGGs in particular, have very fuzzy and irregular boundaries due to their infiltrative nature. Enema (swelling of brain tissue around the tumor) and mass effect (tissue displacement induced by the tumor) are quite uncommon due to the slow-growing nature of the DLGGs. [2]

Segmentation methods can be grouped in two categories:

i) Surface and
ii) Region-based approaches. [3]

The objective of surface based methods is to find the organ or tumour's boundary by propagation a curve/surface with a flow that is determined according to curvature and image constraints (generally the image gradient). Snakes and level sets are typically used in this context. The former defines the object's boundary explicitly as a parametric curve, while the latter defines the contour via an implicit function allowing for more complex geometries and topological changes. [4]

A brain tumor is defined as the growth of abnormal cells in the tissues of the brain *(National Cancer Institute,*. Brain tumors can be benign (noncancerous) or malignant (cancerous). In contrast to normal cells, cancer cells result from uncontrolled cell growth and can grow into adjacent tissue. Although benign tumors can become large and press on healthy organs and tissue, which can potentially affect their functioning, they rarely invade other tissue. Primary brain tumors start from the brain itself, while secondary brain tumors (i.e. metastatic tumors) originate from other parts in the body.

II. LITERATURE SURVEY

Narkhede Sachin et al., 2014 [5] defined the segmentation is a complex problem in the field of medical imaging

despite various presented methods. MR image of human brain can be divided into several sub-regions especially soft tissues such as gray matter, white matter and cerebrospinal fluid. Despite of being a primary clue of image segmentation, the edge information, can't provide good analytical results of images without joining other data. The segmentation of brain tissue in the magnetic resonance imaging (MRI) is very important for detecting the existence and outlines of tumors. Depending on symmetry character of brain MRI image, a segmentation algorithm is presented. The goal was to detect the position and boundary of tumors automatically. **Sudipta Roy, Sanjay Nag,et al., 2013 [6]** defined the tumor segmentation from magnetic resonance imaging (MRI) data is an important but time consuming manual task performed by medical experts. It's a stimulating task to automate the process due to high diversity in occurrence of tumour tissues between different patients. MRI is an advanced medical imaging technique providing rich information about the human soft-tissue anatomy. There are different brain tumor detection and segmentation methods to detect and segment a brain tumor from MRI images. These detection and segmentation approaches are reviewed with an importance placed on enlightening the advantages and drawbacks of these methods for brain tumor detection and segmentation. **Swapnil R. Telrandhe et al., 2016 [7]** proposed adaptive brain tumor detection, Image processing is used in the medical tools for detection of tumor, only MRI images are not able to identify the tumorous region in this paper we are using K-Means segmentation with pre-processing of image. Which contains denoising by Median filter and skull masking is used. Also we are using object labelling for more detailed information of tumor region. To make this system an adaptive we are using SVM (Support Vector Machine), SVM is used in unsupervised manner which will use to create and maintain the pattern for future use. Also for patterns we have to find out the feature to train SVM. For that here we have find out the texture feature and color features. **Ms. Priya Patil et al., 2017 [8**] studied of brain tumor detection and segmentation the MRI Images is very useful in recent years. Due to MRI Images we can detect the brain tumor. Detecting irrelevant development of tissues and blood blocks in nervous system are visible in MRI images. Initially, the detection of brain tumor is to check the symmetric and asymmetric Shape of brain which will define the abnormality. After this step the next step is segmentation which is based on two techniques:

1) F-Transform (Fuzzy Transform)
2) Morphological operation.

These two techniques are used to design the image in MRI. Later, by using design, the boundaries of brain tumour can be detected and calculate the actual area of tumor. In this the f-transform is used to give the certain information like rebuilt of missing edges and extracting the silent edges.

Table 1. Comparison of Review Paper

Author	Year	Paper Name	Technique	Result
P.Kleihues	1993	The new WHO classification of brain tumors.[20]	Brain Pathology	It gives difficult edge distribution Systoles.
D.N.Louis	2007	The 2007 WHO classification central nervous system.[21]	Detection of CNS(Central Nervous System)	The molecular parameter is used for its diagnosis structure
D.J Hemanth	2009	"Effective Fuzzy Clustering Algorithm for Abnormal MR Brain image segmentation"[22]	Abnormal MR Brain Image Segmentation	It gives abnormal MR brain image segmentation accurate region of cancer and batter identification of branch i.e. Stage of Cancer
A.A.Abdullah	2012	Implementation of an improved cellular neural network algorithm for brain tumor detection	Network Neural[23]	It Solves high complex problem and it is used to map an input into a desired output
I.Maiti. and Chakraborty	2012	A new method for brain tumor segmentation on watershed and edge detection algorithm in HSV color model	Watershed and edge detection algorithm in HSv color model [24]	It gives color brain MRI image for very good accuracy result

S. Charutha and M.J Jayashree	2014	An efficient brain tumor detection by integrating modify texture based region growing and cellular automata edge detection	Automated and edge efficient brain tumor detection [25]	The proposed method efficient in treatment of brain tumor and also in removal of tumor
R.Preetha and G.R. Suresh	2014	Performance of analysis of fuzzy C means Algorithm in automated detection of brain tumor	Fuzzy C means Algorithm in Automated detection of brain tumor [26]	The boundary of tissues can be seen clearly

III. TYPES OF BRAIN TUMOR

A primary brain tumor is an abnormal growth that starts in the brain and usually does not spread may be benign or malignant [9].

A ***benign brain tumour*** grows slowly, has distinct boundaries, and rarely spears. Despite the fact that cells are not harmful, this tumour made out of considerate cells and situated in indispensable zones can be considered hazardous.

A *malignant brain tumour* grows quickly, has irregular boundaries, and speeds to nearby brain areas. Despite the fact that they are once in a while called brain tumour, threatening brain tumour don't fit the meaning of growth since they don't spread to organs outside the cerebrum and spinal string [10].

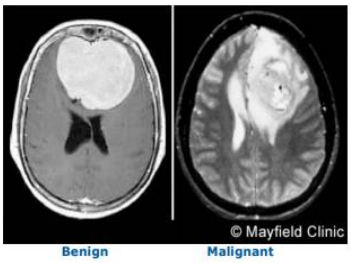

Fig.1: Benign and Malignant

The cancer initiated anywhere in the body and spread out to brain are the Metastatic tumour. They from when cancer cells are carried in the blood stream to the brain. The most common cancers that spread to the brain. The most common cancers that spread to the brain are lung and beast [11].

All tumours have life threatening capabilities, despite of being a benign, malignant or metastatic. Enclosed within the bony skull, the brain cannot expand to make room for a growing mass, resulting in tumour compresses and displaces normal brain tissue. Some brain tumors cause a blockage of cerebrospinal fluid that flows around and through the brain. This blockage increases intracranial pasture and can enlarge the ventricles. Some brain tumors cause swelling. Size, pressure, and swelling all create "mass," which cause many of the symptoms [12].

IV. SIGN OF BRAIN TUMOR AND MRI IMAGES

Several signs and symptoms depending on the size and growth of tumour can develop gradually or quickly. Headaches are common but usually not the only symptom. If a brain tumour causes increased pressure in the skull, you may have headaches, sickness and vomiting. Some people have seizures (fits) or changes in personality, behaviour and thinking [13].

Other symptoms depend on the position of the tumour and how it affects that part of the brain. Depending on the area you may have problems with how you move or speak. Or you may have changes to how you feel, see or hear. Sometimes a tumour can change hormone levels. This can cause symptoms such as irregular periods, infertility, weight gain, high blood pressure, diabetes or mood swings. These symptoms can also be caused by other conditions. Especially, headaches are common symptom of stress, consulting doctor is necessary in all cases [14].

Magnetic Resonance (MR) image enhancement are mainly used for reconstruction of missing or corrupted parts of MR images, image de-noising and image resolution enhancement. While using Magnetic Resonance (MR) images resolution enhancement face many problems like Resolution enhancement of MR images (512 x 512 pixels 2 times more),conservation of sharp edges in the image and conservation and highlighting of details [15].

Fig.2: Magnetic Resonance

VI. EXISTING APPROACH IN FEATURE EXTRACT AND OPTIMIZED

In this section, we described the existing approaches to identify the tumour in brain. Study the feature extraction approach using DWT (Discrete Wavelet Transformation) and Optimized feature and selection of the feature using Genetic Algorithm (GA). [16]

A. Discrete Wavelet Transformation

An advancement of wavelet theory has taken the interest of researchers in its application to image enhancement which is done by noise removing and edge enhancement. Wavelet basis function enables DWT based filtering procedures to adapt to spatial variations. Wavelets are functions generated from one single function Ψ by dilations and translations. The basic idea of the wavelet transform is to represent any arbitrary function as a superposition of wavelets. Any such superposition decomposes the given function into different scale levels where each level is further decomposed with a resolution adapted to that level [17].

DWT is same as hierarchical sub band framework where sub bands are logarithmically spaced in frequency and represent octave-band decomposition. By applying DWT, the image is actually divided i.e., decomposed into four sub bands. These four sub bands arise from separable applications of vertical and horizontal filters. DE noising method corresponding to wavelet relies on the fact that noise commonly manifests itself as fine-grained structure in the image and DWT provides a scale based decomposition. Thus, most of the noise tends to be represented by wavelet co-efficient at the finer scales. Dumping such coefficients results in natural filtering of the noise on the basis of scale. Because the coefficients at such scales also tend to be the primary carriers of edge information, this method threshold the DWT coefficients to zero if their values are below threshold. Such coefficients are corresponding to noise. The edge relating coefficients on the other hand, are usually above the threshold. The Inverse DWT of the threshold coefficients is the denoised image.

B. Genetic Algorithm

Genetic algorithms determine the optimal value of a criterion by simulating the evolution of a population until survival of best fitted individuals. The survivors are individuals obtained by crossing-over, mutation and selection of individuals from the previous generation. We think that GA is a good candidate to find out the optimal combination of segmentation results for two main reasons. First one is due to the fact that an evaluation criterion is not very easy to differentiate. GA is an optimization method that does not necessitate to differentiate the fitness function but only to evaluate it. Secondly, if the population is important enough considering the size of the search space we have good guarantees that we will reach the optimal value of fitness [18].

GA is a special form of local search that models our own understanding of evolution. In essence a number of simultaneous agents (the population) each having an encoded state (the chromosome) perform a random walk (mutations) around the search space, while forming new solutions via joining the solutions already in use (crossover) and, thus adjusting and refocusing the efforts of the search on exceptionally good areas once located. While the implementation of GA, several significant alternatives were used like: encode the population (Integer, binary, decimal, etc.), population mutation (mutate one or all genes), parent selection for crossovers and lastly fitness function for evaluation. Though these choices seem complex, in situations where the energy functional has hundreds or even thousands of dependent variables and parameters these few choices can yield nearly optimal values for all variables and parameters concerned [19].

IV. CONCLUSION

This paper surveys the various techniques that are part of Medical Image Processing and are prominently used in discovering brain tumors from MRI Images. At first the various methods that are being currently used in medical image processing were extensively studied. This involved studying the available research. Based on that research this paper was written listing the various techniques in use. A brief description of each technique is also provided. Also of all the various steps involved in the process of detecting tumors, Segmentation is the most significant and propitious. They have accomplished a partial survey of various classification techniques for MRI brain image. A comparative study is made on various techniques. After evaluation of well-known technique it is clearly shown the various methods which can detect the tumor efficiently and provide accurate result. This work will be extended for discrete wavelet and genetic algorithm for brain tumor detection which will provide more efficient result than the existing methods.

V. REFERENCES

[1] Smith, Stephen M., Mark Jenkinson, Mark W. Woolrich, Christian F. Beckmann, Timothy EJ Behrens, Heidi Johansen-Berg, Peter R. Bannister et al. "Advances in functional and structural MR image analysis and implementation as FSL." *Neuroimage* 23 (2004): S208-S219.

[2] Szilagyi, László, Zoltán Benyo, Sándor M. Szilágyi, and H. S. Adam. "MR brain image segmentation using an enhanced fuzzy c-means algorithm." In *Engineering in Medicine and Biology Society, 2003. Proceedings of the 25th Annual International Conference of the IEEE*, vol. 1, pp. 724-726. IEEE, 2003.

[3] Li, Chang-Tsun, and Randy Chiao. "Multiresolution genetic clustering algorithm for texture segmentation." *Image and Vision Computing* 21, no. 11 (2003): 955-966.

[4] Nordin, Peter, and Wolfgang Banzhaf. "Programmatic compression of images and sound." In *Proceedings of the 1st annual conference on genetic programming*, pp. 345-350. MIT Press, 1996.

[5] Sachin, Narkhede, Deven Shah, Vaishali Khairnar, and Sujata Kadu. "Brain Tumor Detection Based on Bilateral Symmetry Information." *arXiv preprint arXiv:1412.3009* (2014).

[6] Roy, Sudipta, Sanjay Nag, Indra Kanta Maitra, and Samir Kumar Bandyopadhyay. "A review on automated brain tumor detection and segmentation from MRI of brain." *arXiv preprint arXiv:1312.6150* (2013).

[7] Telrandhe, Swapnil R., Amit Pimpalkar, and Ankita Kendhe. "Detection of brain tumor from MRI images by using segmentation & SVM." In *Futuristic Trends in Research and Innovation for Social Welfare (Startup Conclave), World Conference on*, pp. 1-6. IEEE, 2016.

[8] Patil, Ms Priya, Ms Seema Pawar, Ms Sunayna Patil, and Arjun Nichal. "A Review Paper on Brain Tumor Segmentation and Detection." International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, Vol. 5, Issue 1, January 2017.

[9] Bauer, Stefan, Roland Wiest, Lutz-P. Nolte, and Mauricio Reyes. "A survey of MRI-based medical image analysis for brain tumor studies." *Physics in medicine and biology* 58, no. 13 (2013): R97.

[10] Somwanshi, Devendra, Ashutosh Kumar, Pratima Sharma, and Deepika Joshi. "An efficient brain tumor detection from MRI images using entropy measures." In *Recent Advances and Innovations in Engineering (ICRAIE), 2016 International Conference on*, pp. 1-5. IEEE, 2016.

[11] Bhattacharyya, Debnath, and Tai-hoon Kim. "Brain tumor detection using MRI image analysis." In *International Conference on Ubiquitous Computing and Multimedia Applications*, pp. 307-314. Springer, Berlin, Heidelberg, 2011.

[12] Chandra, G. Rajesh, and Kolasani Ramchand H. Rao. "Tumor detection in brain using genetic algorithm." *Procedia Computer Science* 79 (2016): 449-457.

[13] R. Spoorthi, N. Apoorva, Arpitha Sreenivasa, and Disha D. Athavar. "SURVEY PAPER ON BRAIN TUMOR SEGMENTATION TECHNIQUES." Volume 6, 4, April (2017), ISSN: 2278 – 1323.

[14] I. Ali, Cem Direkoğlu, and Melike Şah. "Review of mri-based brain tumor image segmentation using deep learning methods." *Procedia Computer Science* 102 (2016): 317-324.

[15] S.Ana, Cathy J. Price, Laura Mancini, Goulven Josse, Alice Grogan, Adam K. Yamamoto, Sharon Geva, Alex P. Leff, Tarek A. Yousry, and Mohamed L. Seghier. "Automated identification of brain tumors from single MR images based on segmentation with refined patient-specific priors." *Frontiers in neuroscience* 7 (2013).

[16] Veeravarmal, V., R. Nirmal Madhavan, M. Mohamed Nassar, and R. Amsaveni. "Central odontogenic fibroma of the maxilla." *Journal of oral and maxillofacial pathology: JOMFP*17, no. 2 (2013): 319.

[17] Havaei, Mohammad, Francis Dutil, Chris Pal, Hugo Larochelle, and Pierre-Marc Jodoin. "A convolutional neural network approach to brain tumor segmentation." In *International Workshop on Brainlesion: Glioma, Multiple Sclerosis, Stroke and Traumatic Brain Injuries*, pp. 195-208. Springer, Cham, (2015).

[18] Aswathy, S. U., G. Glan Deva Dhas, and S. S. Kumar. "A survey on detection of brain tumor from MRI brain images." In *Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2014 International Conference on*, pp. 871-877. IEEE, (2014).

[19] Patil, Ms Priya, Ms Seema Pawar, Ms Sunayna Patil, and Arjun Nichal. "A Review Paper on Brain Tumor Segmentation and Detection." ISO 3297:2007 Certified Vol. 5, Issue 1, January (2017).

[20] Kleihues, Paul, Peter C. Burger, and Bernd W. Scheithauer. "The new WHO classification of brain tumours." *Brain pathology* 3, no. 3 (1993): 255-268.

[21] Louis, David N., Hiroko Ohgaki, Otmar D. Wiestler, Webster K. Cavenee, Peter C. Burger, Anne Jouvet, Bernd W. Scheithauer, and Paul Kleihues. "The 2007 WHO classification of tumours of the central nervous system." *Acta neuropathologica* 114, no. 2 (2007): 97-109.

[22] Selvathi, D., and J. Anitha. "Effective fuzzy clustering algorithm for abnormal MR brain image segmentation." In *Advance Computing Conference, 2009. IACC 2009. IEEE International*, pp. 609-614. IEEE, 2009.

[23] Abdullah, Azian Azamimi, Bu Sze Chize, and Yoshifumi Nishio. "Implementation of an improved cellular neural network algorithm for brain tumor detection." In *Biomedical Engineering (ICoBE), 2012 International Conference on*, pp. 611-615. IEEE, 2012.

[24] Maiti, Ishita, and Monisha Chakraborty. "A new method for brain tumor segmentation based on watershed and edge detection algorithms in HSV colour model." In *Computing and Communication Systems (NCCCS), 2012 National Conference on*, pp. 1-5. IEEE, 2012.

[25] Charutha, S., and M. J. Jayashree. "An efficient brain tumor detection by integrating modified texture based region growing and cellular automata edge detection." In *Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2014 International Conference on*, pp. 1193-1199. IEEE, 2014.

[26] Preetha, R., and G. R. Suresh. "Performance analysis of fuzzy c means algorithm in automated detection of brain tumor." In *Computing and Communication Technologies (WCCCT), 2014 World Congress on*, pp. 30-33. IEEE, 2014.