Review of Tumor Detection in Brain MRI Images

Deepika Joshi, Rohit Goyal
Assistant Professor,
Himgiri Zee University, Dehradun, India

Abstract— Brain tumor is basically a malformed growth of the cells within brain that may be cancerous or non-cancerous. And as we know that the Brain tumor is one of the most life-threatening diseases and so its detection should be fast and accurate. This can be achieved by the execution of automated tumor detection techniques on medical images. Many automated techniques which use image segmentation have been proposed. To learn about tumor detection in MRI Images, a review process involving 2 stage approaches has been undertaken for 30 research papers which were published in the period of year 2000 to year 2015. After an exhaustive review process, two key issues were found "Image Restoration, Enhancement of image" which have been resolved and explained with proper methodologies. Several solution approaches have been found in the 30 papers. This paper provides an outcome of the review which is in the form of various findings, found under various key issues. The findings included algorithms and methodologies used to solve particular research problem, along with their strengths and weaknesses and the scope for the future work in the area.

Keywords— MRI , Segmentation,Enhancement, Restoration

I. INTRODUCTION

A tumor is also known as neoplasm, a growth in the abnormal tissue which can be differentiated from the surrounding tissue by its structure. A tumor growth takes place within the skull and interferes with normal brain activity. A tumor may lead to the cancer, which is a major leading cause of death and responsible for around 13% of all deaths world-wide. The National Cancer Institute (NCI) had estimated that 22,070 new cases of brain and other central nervous system (CNS) cancers would diagnosed in the United States in 2009. The American Brain Tumor Association (ABTA) clarifies this statistic further estimating that 62,930 new cases of primary brain tumors would be diagnosed. Cancer incidence rate is growing at an alarming rate in the world. Most of the current conventional diagnosis techniques are based on human's experience in interpreting a MRI-scan for the judgment; certainly this increases the possibility to false detection and also the identification of brain tumor. On the other hand, applying digital image processing ensures the quick and precise detection of the tumor. Brain tumor analysis is done by doctors but its grading gives different conclusions which vary from one doctor to the another. So for ease of doctors, a research was done which made the use of software with edge detection and also segmentation methods, which gave the edge pattern and segment of brain and brain tumor itself. Medical image segmentation been a vital point of research, as it inherited complex problems for the proper diagnosis of brain disorders. Radiologists examines that the patient physically by using Computed Tomography (CT scan) and Magnetic Resonance Imaging (MRI). MRI images has showed the brain structures, tumor's size and location. MRI's use radiofrequency and magnetic field to result the image's human body without ionised radiations. Imaging plays a central role in the diagnosis of brain tumors. On MRI, they also appear that either hypo (darker than brain tissue) or iso tense (same intensity as brain tissue) on T1-weighted scans, or may be hyper intense (brighter than brain tissue) on T2-weighted MRI. The parts on which immediate changes in grey tones occur as in the images are basically called edges. Edge detection techniques transform images to edge images benefiting from the changes of the grey tones in images. As a result of this transformation, edge based brain segmentation image is obtained, without any changes in physical qualities of the main image. From the MRI images the information such as the tumors location provided the radiologists, an easy way to diagnose the tumor and plan the surgical approach for its removal.

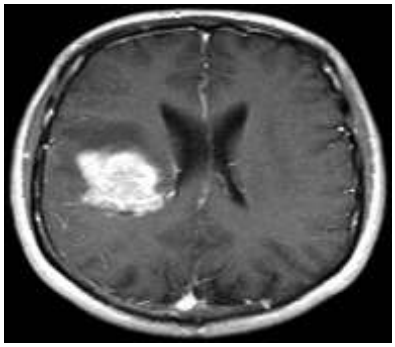

Figure 1. The presence of Brain Tumor

Technique used for brain tumor detection using image processing has been present for few decades. Researchers have proposed many of the semi-automatic and many automatic image processing techniques to detect brain tumors but most of them fail to give effective and also the precise results due to presence of noise, inhomogeneity, poor images contrast that occur usually in the

medical images. Brain tumor segmentation is difficult due to complex brain structure but early and accurate detection of the tumors, edema and the necrotic tissues are very important for diagnostic system. Tumors can damage normal brain cells and by producing the inflammation, exerting pressure on parts of the brain and increasing pressure within the skull. Presently existing algorithms in the medical image processing it employ the partial differential equations, curvature motivated flows and diverse the mathematical models. The image captured from a tumors brain shows the place of infected portion of brain. The image does not give information about numerical parameters such as area and volume of the infected portion of the brain. After the preprocessing of images, first the image segmentation is done by using region growing segmentation. The segmented image shows unhealthy portion clearly. From this image the infected portion (tumor) is selected by cropping the segmented image. And From this cropped image, area is calculated. However, the amount of data is far too much for manual analysis that has been one of the biggest obstacles in the effective use of MRI. The detection of tumor requires several processes on the MRI images that include image preprocessing, feature extraction, image enhancement and classification. Final classification process concludes that a person is diseased or not. Although numerous efforts and promising results were obtained in the medical imaging area, reproducible segmentation and classification of abnormalities are still the challenging task because of its different shapes, locations and image intensities of different types of tumors

I. Review Process Adopted

A literature review is necessary to know about research area and what problem in that area has been solved and need to be solved in the future. This review process approach was divided into five stages in order to make process simple, adaptable. The stages were:-

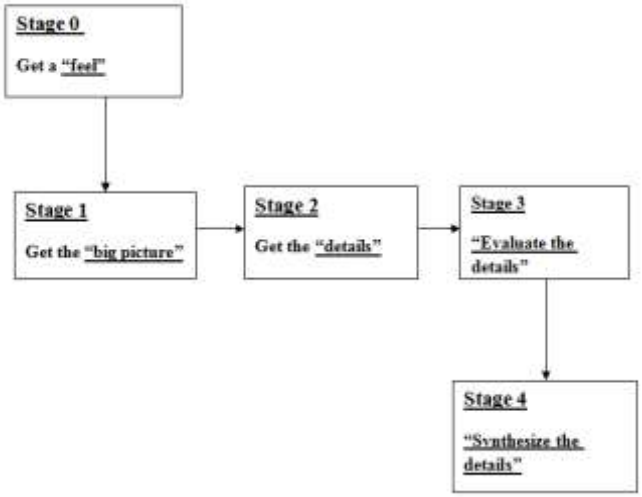

Fig: Review Process Adopted

Stage 0: Get a "feel":

This stage provides the details to get checked while starting the literature survey with a broader domain and classifying them according to the requirements.

Stage 1: Get the "big picture"

The various groups of the research papers are prepared according to the common issues & the application sub areas. In order to understand the paper, it is necessary to find out the answers to certain questions by reading the Title, Abstract, conclusion, introduction and section and sub section headings.

Stage 2: Get the "details"

Stage 2 deals with going in the depth of each research paper and to understand the details of methodology used to justify the problem, justification to significance & the novelty of the solution approach, precise question addressed, major contribution, scope & limitations of the work that was presented.

Stage 3: "Evaluate the details"

This stage evaluates the details in relation to significance of problem, Novelty of problem, significance of the solution, novelty in approach, validity of claims etc.

Stage 4: "Synthesize the detail"

Stage 4 deals with the evaluation of the details presented and generalization to some extent. The stage deals with synthesis of the data, concept & the results presented by the authors

II. Various Issues in the Area

After reviewing 30 research papers on brain tumor detection we have found following issues, which have been listed as under. The issues are

1) **Image Restoration**
2) **Enhancement of Image**
3) **Problem of tumor detection from MRI images**
4) Issue wise discussion

Issue 1:- Image Restoration. Some approaches were used for this issue which are Mathematic Morphology, Watershed Segmentation, combined clustering and classification mechanisms are performed for image restoration. Data model of the MRI Images has also been proposed. The selection in different data performed at cuboids level. For better sup By these solution approaches , MRI Images can be properly handled.

Issue 2:- Enhancement of Image

Multi-Modality Framework, Hybrid Algorithm, Hierarchical Self Organizing Map, Scalp EEG with Modified Wavelet-ICA are the approaches that have been given . Multi-Modality Framework involves some elements and then scan he MRI and CT Scan images in order to modify or find the tumors from images. Hybrid Algorithm solves the developing problem of effected areas of brain by many intelligence methods. Hierarchical Self Organizing Map scans 110 abnormal and 62 normal axial MRI images and the accuracy obtained by it is 92.41. Scalp EEG with Modified Wavelet-ICA do the global thresholding of the images.

Issue 3:- Problem of tumor detection from MRI Images.

The technique of "PCA Based Reconstruction" for CT Scans and MRI database solves the problem of evaluation and analysis of data and decision making process. The data collected from distributed data bases and provides integrated data, which is used with other data for analysis purpose then extract valid, relevant information from databases.

III. Issue Wise Solution Approaches Used

The solution approaches under the various issues have been shown in the **Table 1.1 to 1.3**, which includes additional information like hardware, software, variable/parameters used along with results obtained. The same table also describes the comparative analysis between various solution approaches.

IV. Issue Wise Discussion On Results

5) Issue1:- Image Restoration problem

S.No	Solution Approach	Results	Ref
1.	Mathematic Morphology	based on the histogram peaks of the image to find particular threshold values. no need of previous information.	[3]
2.	Watershed Segmentation	It is based on discontinuity detection.	[1]

Table 6.1 Issue wise Solution Approaches & Result

Issue 2:- Problem of Enhancement of Image

S.No	Solution Approach	Results	Ref.
3	Hierarchical Self Organizing Map	fuzzy uses partial membership therefore more useful for real problems	[6]
4	Scalp EEG with Modified Wavelet-ICA	results are more stable, detected boundaries are continuous	[8]

Table 6.2 Issue wise Solution Approaches & Result

Issue 3:- Problem of tumor detection from MRI Images

S.No	Solution Approach	Results	Ref
5.	PCA Based Reconstruction	Early warning systems which helps in working of differential equations	[12]
6.	Region Based Method	evaluation and analysis of valid , relevant information from MRI databases.	[12]

Table 6.3 Issue wise Solution Approaches & Result

Common Findings

Issue 1:- Image Restoration problem

- In the contour deformable model with regional base technique, the performance was not sufficient to obtain fine edge in the tumor.
- The worst Approach is spatial classification and spatio-temporal association data because they require time consuming computations and available analytical operations are limited in them.

Issue 2:- Problem of Enhancement of Image

- The best approach is Task driven approach because it is independent of the type of data & also is operational and depends upon the tasks carried out on data.
- The worst approach is of domain driven method. It is driven by the data & depends entirely on the domain knowledge of extracted data.

Issue 3:- Problem of tumor detection from MRI Images

- The best approach is Ontology based approach to intelligently scan the data because the ability of the different MRI data to collect information accurately enables building both real-time detection and rarely warning systems .
- Worst approach is the Traditional data analysis techniques because of insufficiency and also could not support, handle huge and the complex biological data.

V. SCOPE FOR THE WORK IN AREA.

- To increase the flexibility to be compatible with data, our system allows users to use any programming language to obtain the new results. Thus, data researchers can also implement new algorithms using their own analysis tools (from Matlab and to C/C++) as far as the users write results into text files with pre-defined formats.
- The insights from visualization can be used to guide further data. Meanwhile, the results from the next round of MRI data can be visualized which allows users to obtain the new insights and to develop more hypotheses with the data.

VI. CONCLUSION

The review of the 30 research papers has been carried out in the area of brain tumor detection from different images to investigate and to find out the current challenges and scope of work. After the review, we found several issues which should also be given proper concern, when the effective mining of data takes place. These papers are a survey of different tumor detection issues that affect the related work that carried out in the area of tumor detection. Purpose of these methods and techniques is to reduce the imperfection in results and inefficiencies that occurs while detection of tumor. We have found various issues for which specific methods and techniques have been discussed.
The exhaustive review has finally lead to extract findings in the area of tumor detection, strengths and weaknesses and scope of work during M. Tech Research work.

II. FUTURE WORK

Research in the field of medical imaging in recent years a great effort has been focused on segmentation of brain tumors. Automatic segmentation by the freeing physicians from the burden of manual labeling has great potential in clinical medicine; only the quantitative measurement of the disease modeling allows tracking and recovering while. MR usually during early stages of disease is more sensitive in detecting abnormalities of the brain, and cerebral infarction, brain tumor, or infection in early detection of the cases is excellent. In future the method can be produced that provide very good results in enhancing, detecting and segmenting the brain tumor from a MR image.

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