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Brain Tumor Identification & Segmentation using an Efficient Learning Algorithm: A Review

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Abstract - The long-term goal of this work is the characterization of atherosclerosis lesions in vivo using Magnetic Resonance Imaging (MRI). Its particular interest is the computer-aided diagnosis and staging of the disease, especially the detection of vulnerable plaques. MRI is an extensively used technique which facilitates the diagnosis and prognosis of brain tumors in many neurological diseases and conditions. Standard MRI sequences are generally used to differentiate between different types of brain tumors based on visual qualities and contrast texture analysis of the soft tissue. In this work, an automatic brain tumor region detection scheme is reviewed based on the variation of intensity distribution in volumetric tumor and non-tumor region. All related work have been reviewed with various techniques.

Keywords: *Image Processing, Brain Tumor, Energy Optimization etc.*

I. INTRODUCTION

In view of measurements of the Central Brain Tumor Registry of the United States (CBTRUS), mind tumor is one of the main source of malignant growth related passing's in the United States. It is the subsequent driving reason for malignant growth related passing's in kids under the age 20 just as in guys ages 20-39. The most widely recognized essential mind tumor, cerebrum tumors that start and tent to remain in the cerebrum, is meningioma with 34%, anyway glioma, an expansive term including tumors emerging from the gluey or steady tissue of the cerebrum (30% of all mind tumors), speaks to 80% of harmful tumors making it the most well-known essential cerebrum tumor causing demise. Because of the expanding number of patients, the quantity of procured information increment, as well. Along these lines, there is expanding need of programmed calculations that can procedure the information naturally. Subsequently, there have additionally been expanding enthusiasm for growing such calculations and, especially, the programmed cerebrum.

X-ray is an imaging system which is more valuable than then X-beam. MR pictures don't utilized unsafe radiations and give them enough data to ailment analysis and basic leadership for the specialists. MR Images are utilized in pre-preparing of mind tumor discovery and conclusion [1]. Various kinds of MRI are utilized in this system as indicated by the necessity. Sort of arrangements utilized in MRI gave as a contribution to the pre-processing step like T1, T2 and FLAIR. To comprehend the idea of various kinds of MRI pictures, it is important to clear the idea of the TE and TR. TE is the (hour of reverberation) time distinction between the conveyance of RF beat and the getting of reverberation signal. TR is (redundancy time) the gathering time between two ceaseless heartbeats applied in an equivalent succession.

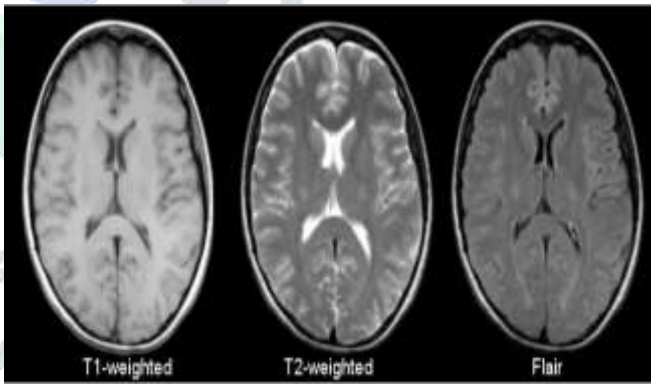

Figure 1: Type of MRI Imaging Technique [1]

This work is introduced as pursues. In Section II, It portrays the related work regarding brain tumor detection. Zone III related with MR image and brain tumor and importance of them. The methodology is explained in section IV. Problem formulation is presented in section V and main conclusion is provided in section VI.

II. LITERATURE REVIEW

MRI is an extensively used technique which facilitates the diagnosis and prognosis of brain tumors in many neurological diseases and conditions. Standard MRI sequences are generally used to differentiate between different types of brain tumors based on visual qualities and contrast texture analysis of the soft tissue. The brain tumor detection and classification system is implemented using CWT, DWT and SVMs. The proposed method uses

different levels for wavelets, the high accuracy part is obtained using CWT. This work provides the related work of brain tumor images.

Dr Jagan. A et. al. [13] presented the Segmentation of brain MR Images plays prime role for measuring and visualizing the brain anatomical structures, analyzing brain tumors, and surgical planning. The proposed augmentation method was tested on 10 patients Fluid-Attenuated Inversion Recovery 3D Brain MR Image dataset and obtained the following average segmentation results accuracy was 97.59 %, sensitivity was 97.59 % and the specificity was 97.59 %. With the final outcome of development in segmentation results, this research work absolutely and satisfyingly propose the possibilities of improved segmentation results of Fluid attenuated Inversion Recovery 3D brain MR Images. Kurnar. M et. al. [14] presented the Brain tumor segmentation in magnetic resonance imaging (MRI) had become a research area in the field of medical imaging system. The area of tumor was then calculated. The software used in this paper was Scilab which was open source software and the whole application can also be used for tumor for tumor developed in other parts of today. In future Artificial Intelligence can be made relatively faster. Xavier. S et. al. [15] presented the data mining was a best technique in many fields and it had wide application in healthcare industry such as identifying healthcare patterns from large medical datasets, decision making, and providing early stage treatment to the patients. We can use data mining techniques to detect disease like brain tumor. Using the above proposed method brain tumor disease can be classified and diagnosed from brain MRI. Pre-processing and skull removal process will increase the performance of the system. The system can also give disease description along with healthy advices that may help the user. The system will provide better accuracy with GA-SVM classifier and will increase the decision making capacity Yang. T et. al. [16] presented the brain tumor images segmentation plays a crucial role in the auxiliary diagnosis of disease, treatment planning and surgical navigation. It used the Brats2015 training dataset to carry out the verification experiment, and prove the effectiveness and robustness of the proposed algorithm in comparison with the expert manual segmentation results. In addition, through the comparison with other excellent algorithms, we found that the proposed algorithm achieves the most accurate segmentation results in the complete tumor and enhanced tumor regions, which proves the advanced nature of the our algorithm. Jemimma. T et. al. [17] Author present the brain tumor detection was a tedious task in the field of medical imaging. This paper proposed the state of art tumor detection techniques using the Watershed Dynamic Angle Projection-Convolution Neural Network (WDAPP-CNN) The segmentation and classification of MRI brain image were necessary for the proficient diagnosis of brain tumor. The experimental results were implemented through the BRATS database which achieves better dice score efficiency 93.5% and sensitivity 94.2%. In the future work, for classification and segmentation of brain tumor, some other different features can be compared to get more accuracy. It can also be extended to identify the other types of tumors such as a pancreatic tumor, adenomas, fibromas. Marszalik. D et. al. [18] presented the During resection of tumors, which were located inside the brain, normal tissues were also destroyed. It may be reason of permanent brain damage and loss or lesion of some bodily functions. Therefore damages minimization during tumour removing was such important. Knowledge of the tumour localization gives opportunity to planning of path to the tumour and method of its resection. The finding of a balance between the trajectory length and the distance to the critical structure was a very important issue and was still matter of research. Rahman. M et. al. [19] presented the tumor cell was a form of cell that develops out of control of the ordinary forces and standardizes growth. Brain tumor was one of the major reasons for human death every year. Around 50% of brain tumor diagnosed patient die with primary brain tumors each year in the United States. If experts intra and inters observation variability issues can be minimized then in future it will be possible to increase the accuracy rate. The experimental results showed that the proposed approach was able to perform better results compared to existing available approaches in terms of accuracy while maintaining the pathology experts' acceptable accuracy rate. Sahu Y. et al. [20] presented Tumor Detection with help of MATLAB image processing having three stages Pre-processing, Processing and Post processing in morphological detection. After the getting MRI report first stage is pre-processing which is converting the original RGB image to gray-scale image and then Gaussian high pass filter for noise reduction In the second stage processing system for pixel enhancement we uses Median filter and in third stage is the post-processing which Entropy Filter., Standard Deviation Filter (SDF), Weiner Filter, Gradient Magnitude ,Regional Maxima for various different-different results. Hussain A. et al. [21] presented that brain tumor segmentation process was performed for separating brain-tumor tissues from brain MRI images, The MRI images should be filtering such as with the median filtering technique and skull stripping should be done in pre-processing, the thresholding process is being done on the given MRI images with using the watershed segmentation method. Then at last the segmented tumor region is obtained. And then in other phase features extracted by GLCM methods using MATLAB software. Swami M. et al. [22] processed radiograph CT and MRI images to perform detection of brain tumour using a hybrid algorithm based on image processing and segmentation. The database taken is from Google open source brain scans and the system has been developed on MATLAB v2019 for Windows.

III. BRAIN TUMOR & MAGNETIC RESONANCE

In health sectors, brain tumour measurements are obtained mainly by radiologists, who measure the tumour manually through widely available imaging software on MRI/CT scans. The approach has been followed since the development of medical imaging. This work proposes a system based on the morphological operation of erosion, denoising, and thresholding based tumour segmentation method.

Diverse Image preparing strategies and methods are utilized to make the picture all the more clear and upgraded with the goal that precise conclusion can be performed. Various ways are embraced for this reason however the focused on territory of this examination is constrained to the significant advances like filtration, picture division, highlights extraction choice and characterization. These significant procedures will prompt exact conclusion of tumor from cerebrum MR pictures. Picture investigation framework gives a proficient method to break down the restorative picture and identify the variations from the norm of those pictures. This investigation framework will ready to uncover increasingly conceivable part of pictures by applying the dim scaled division with the development arrangement method of neural system which is neural

system. This test gives the best blend to picture examination framework. The graphical portrayal of proposed work is given underneath. The proposed work is isolated into two sections. First is pre-handling and second is post ace preparing. Dataset of mind MR Images are utilizing as an info. For the usage different cerebrum MRI pictures are utilized in which likewise contain non-tumor and tumor influenced pictures. The arrangement of downloaded pictures is in .gif anyway expected to change over it in .png design with the goal that it tends to be effectively utilized by Matlab condition.

The American Cancer Society (http://www.cancer.org , accessed on June 27, 2009) estimated that 22,070 malignant tumors of the brain or spinal cord (12,010 and 10,060 in men and women, respectively) will be diagnosed during 2009 in the United States. Approximately 12,920 people (7,330 men and 5,590 women) will die from these tumors in 2009. This would account for about 1.5 % of all cancers and 2.3 % of all expected cancer-related deaths in 2008. In children, brain and spinal cord tumors are the second most common cancers. These tumors account for about 21 % of all childhood cancers. Around 3,400 CNS tumors are diagnosed each year in children under the age of 20 and around one fourth of these are considered benign tumors.

1. Diagnosis

Symptoms of brain tumors, ranging from headache to stroke, may differ among people since they depend on the size and position of the tumor in the brain and the functions that are controlled by that part of the brain. The National Brain Tumor Society lists the following symptoms: a new seizure in an adult, gradual loss of movement or sensation in arms or legs, unsteadiness or imbalance (especially if it is associated with headache), loss of vision in one or both eyes (especially if the vision loss is more peripheral), double vision (especially if it is associated with headache), hearing loss with or without dizziness and speech difficulty of gradual onset. In addition, nausea or vomiting, confusion and disorientation, and memory loss may be observed.

Brain tumor diagnosis usually involves several steps. The personal and family medical history is reviewed and a complete physical examination is performed to verify the general signs of health, including signs of disease. A neurological examination commonly evaluates the mental status and it involves testing muscle strength, eye and mouth movement, reflexes, alertness, coordination and other functions. Apart from tumor marker tests, gene testing and lumbar puncture, imaging tests are usually performed. MRI and CT scans are used most often to diagnose brain diseases. Unlike MRI, a CT scan is based on X-rays. The technique provides a series of detailed pictures, which are taken from different angles. A contrast dye may be injected into the veins or swallowed to show more clear differences in the tissues of the brain. During an MRI acquisition, detailed images of the brain are obtained, and contrast agents are used. MR images of brain tumors are in general superior to CT scan images due to the superior soft tissue contrast in MRI. In addition, functional imaging data, identifying functional
pathways (e.g. motor, speech, vision), and MR spectroscopy data, providing metabolic information, can be obtained together with the MRI acquisition.

2. Treatment

Treatment of brain tumors depends on a number of factors such as the type, location and size of the tumor. Other factors that are taken into account are the age and general health of the patient. Several types of treatment may be used for CNS tumors, including surgery, radiotherapy, chemotherapy, and currently developed innovative targeted therapies. In many cases combination therapy is used [3].

If the location of a brain tumor is accessible for surgery, the neurosurgeon may remove as much as possible of the tumor. Removal of even a portion of the brain tumor may help to reduce signs of elevated intracranial pressure. In addition, surgery can reduce the amount of tumor that needs to be treated by radiation or chemotherapy. Craniotomy is the main type of operation for brain tumor treatment. It involves making an incision in the scalp, folding back the skin and removing the piece of bone over the tumor. The neurosurgeon can remove the tumor or part of it in different ways depending on the amount of blood vessels and how hard or soft it is. Usually the removed piece of bone is brought back to its place and fastened to the skull with metal screws and plates, wires, or stitches. The risks of surgery might be too high for certain tumors when they are located near vital areas in the brain and some tumors that tend to spread diffusely are also not cured by surgery.

Radiotherapy or radiation therapy involves the use of ionizing radiation for cancer treatment to control malignant cells. High-energy rays or particles are often used when surgery is not possible, but it can also be used to treat remaining tumor tissue after surgery. Different approaches exist for radiation therapy. In general, external radiation treatments are fractionated into many small doses and are given over a period of time (e.g. five days a week for several weeks). This schedule depends on the age of the patient and the type and size of the tumor. External radiation may be directed just to the tumor, the surrounding tissue or the entire brain. In the latter case, the patient often receives an extra dose of radiation to the tumor area.

3. Classification

Brain tumors are classified based on the type and location of the cells that originate from the tumor, while the degree of malignancy is characterized by the grade. The grade of a tumor is based on how abnormal the cancer cells are and how quickly the tumor is likely to grow and spread. Grade I tumors grow slowly and rarely spread to other tissues. The cells are relatively similar to normal cells and the tumor may be removed by surgery. Grade II tumors grow slowly, but may spread to nearby tissue and may recur. Some of these tumors may become higher-grade tumors. Grade III tumors grow quickly and are likely to spread into nearby tissue.

The tumor cells look very different from normal cells. Grade IV tumors grow and spread very quickly. The cells are completely different from normal cells and there may be areas of dead cells. A detailed histological and genetic typing of tumors of the CNS is provided by the World Health Organization (WHO). Most of the cases that are used in this work belong to the class of meningiomas, metastases or gliomas. Meningiomas grow from the meninges, which are the layers of tissue covering the brain and spinal cord. Meningioma is the most common brain tumor in adults and it is approximately twice as common in women as in men. As they grow, meningiomas can press on adjacent brain tissue or the spinal cord, causing symptoms as headache or weakness in an arm or leg. Most

meningiomas are benign, tend to grow slowly, and can be cured by surgery [4].

IV. RESEARCH METHODOLOGY

In the machine learning and pattern recognition field, researchers develop methods and computer programs to perform a certain task. In this context, certain learning methods try to optimize a performance criterion using example data or past experience. In case of supervised learning the learning methods are adopted based on these examples (i.e. the learning or training phase), which include output values. When the output values indicate the different categories to which the examples belong, this learning task is called classification.

1. K-Nearest Neighbor

The k-nearest neighbor (KNN) algorithm is based on a distance function to measure the similarity or difference between data points. In order to determine the class of a new data point x, the distance between x and xi is computed. A distance function that is often used for this purpose is the Euclidean distance. The KNN algorithm determines the k data points that are the nearest to x and classifies it according to the majority of equal classifications in this group. Data normalization can be used to avoid that the variable with the largest scale dominates the distance measure.

2. Discriminant Analysis

Since Fisher's linear discriminant analysis (FLDA) was introduced in 1936, it has been widely applied for numerous classification problems. The method aims to discriminate between classes in an underlying space by finding a projection.

3. Multi-Layer Perceptron

The multi-layer Perceptron (MLP) is a popular type of artificial neural network (ANN) model, which is known to be a universal approximates. In case of an MLP with one hidden layer the outcome is obtained by feeding the data point x(∈ Rd) to the hidden layer, consisting of H hidden units, which are themselves connected to the outcome unit. The model parameters consist of all weights and bias terms and can be estimated by minimizing the cross-entropy error function for binary classification. For regularization purposes, an additional term can be added to keep the estimated weights small. There exists a wide variety of methods to optimize the objective function. The back propagation method is used to propagate the errors backward through the network.

V. PROBLEM FORMULATION

This investigation of cerebrum MR Images is useful in mind tumor finding process. Tumor and malignancy is an unsafe and outrageous malady for human life. Picture arrangement strategy is effectively improving the procedure of ailment finding. It is a procedure where pictures are named into various predefined classes. A few strategies has been presented for picture grouping like SVM and so on. This investigation is contributing in the field of picture handling by presenting a model which can analyze tumor all the more precisely and proficiently. This examination proposed a model in which fuzzy system is utilized with division of pictures.

VI. CONCLUSION

This work provides a review on brain tumor detection & segmentation with MR images. In health sectors, brain tumour measurements are obtained mainly by radiologists, who measure the tumour manually through widely available imaging software on MRI/CT scans. The approach has been followed since the development of medical imaging. This work proposes a system based on the morphological operation of erosion, denoising, and thresholding based tumour segmentation method. For this, it uses MATLAB tool for implementation performance.

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