ENHANCEMENT AND ISOLATION PROCESS APPLIED ON MRI IMAGES FOR CLASSIFICATION OF BRAIN TUMOUR

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ABSTRACT

The segmentation of brain tumors in magnetic resonance images (MRI) is a challenging and difficult task because of the variety of their possible shapes, locations, image intensities. In this Review paper, it is intended to summarize and compare the methods of automatic detection of brain tumor through Magnetic Resonance Image (MRI) used in different stages of Computer Aided Detection System (CAD). Brain Image classification techniques are studied. Existing methods are classically divided into region based and contour based methods. These are usually dedicated to full enhanced tumors or specific types of tumors. The amount of resources required to describe large set of data is simplified and selected in for tissue segmentation.

Keywords: Magnetic Resonance Image (MRI), Brain Tumor Images. Classification of Brain Image

INTRODUCTION

The Brain cancer is a very serious type of malignancy that occurs when there is an uncontrolled growth of cancer cells in the brain. Brain cancer is caused by a malignant brain tumor. Not all brain tumors are malignant (cancerous). Some types of brain tumors are benign (non-cancerous). Brain cancer is also called glioma and meningioma.Brain cancer is one of the leading causes of death from cancer. There are two main types of brain cancer. They include primary brain cancer, in which the brain cancer originates in the brain itself. Primary brain cancer is the rarest type of brain cancer. It can spread and invade healthy tissues on the brain and spinal cord but rarely spreads to other parts of the body.

Secondary brain cancer is more common and is caused by a cancer that has begun in another part of the body, such as lung cancer or breast cancer that spreads to the brain. Secondary brain cancer is also

called metastatic brain cancer. Brain cancer is most treatable and curable if caught in the earliest stages of the disease. Untreated and/or advanced brain cancer can only spread inward because the skull will not let the brain tumor expand outward. This puts excessive pressure on the brain (increased intracranial pressure) and can cause permanent brain damage and eventually death. This process results in symptoms, such as headache, and other neurological problems. For more details on other key symptoms and complications, refer to symptoms of brain cancer.

THE BRAIN AND THE SPINAL CORD

To understand more about the care of brain tumours, let's first understand the structure and function of the brain and the spinal cord, and what happens when there is a tumour in the brain.The brain and the spinal cord are the most vital parts of our body. They are made up of nerve cells (neurons) and supporting cells (Glial cells) that receive and send messages through nerves and control all the parts of our body.

WHAT IS BRAIN TUMOUR

A brain tumour is a mass of abnormal tissue growing in any part of the brain. For some unknown reason, some brain cells multiply in an uncontrolled manner and form these tumours. These tumours can arise from any part of the brain, spinal cord or the nerves. Broadly these tumours can be divided into benign and malignant tumours.Benign tumours grow slowly and never spread to other parts. But as they slowly increase in size they can cause pressure on the normal brain and interfere with mental and bodily functions. Some of the benign tumours known are: meningiomas, pituitary adenoma, craniopharyngioma, epidermoid cysts, neurocytoma, haemangioma, pilocytic astrocytoma, etc.Malignant tumours or cancers are aggressive tumours that grow fast and infiltrate the surrounding brain and sometimes spread to the other parts of the brain or spine. There are various types of malignant brain tumours like High Grade Astrocytoma/Glioma, ependymoma, PNET, medulloblastoma, lymphoma, Germ cell tumours. With aggressive and timely treatment some of these can be cured.

SOME COMMON SYMPTOMS

Limb weakness and any abnormal sensation in the limbs can be a symptom of a tumour in certain parts

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of the brain especially in and around the motor or sensory cortex. Generally the opposite side is affected i.e right-sided weakness by a tumour in the left motor cortex.

Speech: Ability to understand (sensory aphasia) or express (motor aphasia) may be affected by tumours in certain parts of the brain. Sometimes the person is able to understand but is not able to express properly and may not get the right words.

METHODS OF DETECTING BRAIN TUMER

Most of the symptoms described above are non-specific and can be caused by many other diseases. A detailed history and medical examination is first done by the doctor and if a brain tumour is suspected then further tests like CT or MRI scan, angiogram, CSF test, hormonal blood test or EEG may be done.

CT or MRI Scan produce special X-ray pictures that show the detailed structure of the brain and spine and pick up any abnormality. To get a clearer picture, Iodine or Gadolinium contrast dyes are given intravenously. Some people can develop an allergic reaction to the iodine contrast agent and you should always tell the doctor if you have any allergies. The more expensive non-ionic contrast agents reduce the risk of allergic reaction. There is a strong magnetic field during the MRI scan and you should inform the doctor if you have any Pacemaker or metallic clip or prostheses inside your body. For these scans which take about half an hour, the patient lies down on the couch of these CT or MRI machines. The couch moves the patient through the large aperture or tunnel of these machines. The whole procedure is painless but the noise created by the MRI machines can be disturbing for some patients. During the scan the patient should not move and for small children who may move a lot, sometimes a minor anaesthesia is given.

Angiogram is an X-ray taken after injecting an iodine dye through catheters placed into the arteries. This shows the details of the blood supply to the tumour. For vascular malformation like AVM it is essential to plan embolisation, surgery or stereotactic radiation.

Cerebro Spinal Fluid (CSF) Study is done after removing the CSF from the spine by a long needle (lumbar puncture). This is done in certain tumours which have a high chance of spreading to the spine or to rule out infections or bleeding.

Hormonal Blood Tests are done for tumours like pituitary adenoma, craniopharyngioma, optic chiasmal or hypothalamic glioma.

Electroencephalogram (EEG) is occasionally done to study the pattern of seizures.

TREATMENT

Treatment depends upon the tumour type, patient's age and general condition

- Surgery
- Radiation Therapy
- Chemotherapy

Surgery Surgery is generally the initial and sometimes only treatment required. The aim is to remove as much of the tumour as is safely possible. Before the operation the neurosurgeon carefully studies the CT/MRI scans. The route and type of operation is then decided after discussing the risks and benefits of this operation with the patient. Hair is completely shaved before the operation. The operation is performed after giving anaesthesia to the patient. While it is desirable to remove the tumour completely, this is not always possible if the tumour is very deep-seated or is in a very critical area. Therefore a tumour may be either completely or partially removed or only a biopsy may be taken. High-powered operating microscopes make it easier to see and remove tumours while sparing the normal brain. The operation may take many hours. The patient usually wakes up as soon as the effect of the anaesthesia wears off, but is kept in the ICU for some time to allow close observation and care.

Radiotherapy Radiation Therapy or Radiotherapy (RT) is the use of penetrating X-ray or Gamma ray beams produced by the Telecobalt or Linear Accelerator machines.

Radiotherapy plays a very important role in all malignant tumours and even in some benign brain tumours. Following surgery, radiation therapy targets the remaining tumour cells to prevent or delay its recurrence. Depending upon the sensitivity of different tumour types to radiation and the biological dose of radiation used, these tumours are either completely eradicated (cured) or they shrink or stabilise thus relieving symptoms.The dose, duration and technique of radiotherapy depends upon the type, size, site of the tumour and the patient's age and general condition. For most tumours, only the affected part of the brain with some margins is irradiated. However for some tumours like medulloblastoma, lymphoma and germ cell tumours that have a higher risk of spread to the spine, the entire brain and spine is irradiated.

Treatment Planning using head masks of thermoplastic material (ORFIT), simulator machines and planning computers help in more accurate positioning of the radiation beam for adequate coverage of the tumour while minimising the dose to the normal brain. After studying the CT / MRI scans, surgical and pathology reports, the area to be treated is decided. The path of the radiation beam is then carefully marked on the Thermoplastic mask using the simulator machines.Stereotactic radiosurgery (SRS) and radiotherapy (SRT) are special techniques of radiotherapy which have the potential to reduce the dose of radiation to normal brain and critical structures as compared to conventional radiotherapy. These techniques require a lot of manpower and high technology and are indicated in special types of tumours or conditions. We are also conducting some trials in this regard.

Chemotherapy Chemotherapy is the treatment of certain types of brain tumours with cytotoxic drugs. Chemotherapy is useful for a variety of brain tumours

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including lymphomas, medulloblastomas, germ cell tumours, PNET and some gliomas. Commonly used drugs used for brain tumours are CCNU, BCNU, vincristine, Cisplatin, Temozolomide etc. Generally these drugs are given in combination every 4 to 6 weeks to a maximum of 6 cycles. Sometimes, if one combination of drug regimen stops working for the tumour, another drug or a combination (2nd line) may be tried. Most of the chemotherapy treatment may be administered on an OPD basis although some may require admission. Blood tests for haemoglobin, white blood count and platelets and sometimes, liver and kidney function tests are done before each cycle of chemotherapy.

BRAIN TUMOR IN KIDS

In children brain tumours are the second most common cancer or tumour after leukaemia. The common childhood brain tumours include medulloblastoma, gliomas, astrocytoma, ependymoma, PNET and germ cell tumours. In most children the cause of the brain tumour is not known but in some tumours like the Optic glioma it may be due to a hereditary disease called neurofibromatosis. The effect of the tumour and its treatment on the brain function, mental and physical growth is more pronounced in children with developing brain. There is, therefore, a need for timely diagnoses, treatment and rehabilitation of these children. Fortunately, a majority of childhood brain tumours are curable with modern treatment, and with the medical resources available, these children can be restored to near normalcy. This, however, needs a multidisciplinary approach, which is expensive and rarely available under one roof. Even after completion of the hospital treatment many children require intensive rehabilitation at their homes and sometimes at special institutions.

The World Health Organization had dedicated the last decade to the brain. With remarkable strides in the management of brain tumour there is a need for a foundation to provide the highest level of care to such patients and perform research into various aspects of brain tumours. Brain tumours are the commonest solid tumours in children and in our country affect thousands of young adults each year. We plan to reach out to all patients suffering from brain tumour to help them and their families through this devastating period.

SURGERY IS AVAILABLE FOR BRAIN TUMORS

Surgery is the usual first treatment for most brain tumors. Before surgery begins, you may be given general anesthesia, and your scalp is shaved. You probably won't need your entire head shaved.

Surgery to open the skull is called a craniotomy. The surgeon makes an incision in your scalp and uses a special type of saw to remove a piece of bone from the skull.You may be awake when the surgeon removes part or all of the brain tumor. The surgeon removes as much tumor as possible. You may be asked to move a leg, count, say the alphabet, or tell a story. Your ability to follow these commands helps the surgeon protect important parts of the brain.After the tumor is removed, the surgeon covers the opening in the skull with the piece of bone or with a piece of metal or fabric. The surgeon then closes the incision in the scalp.Sometimes surgery isn't possible. If the tumor is in the brain stem or certain other areas, the surgeon may not be able to remove the tumor without harming normal brain tissue. People who can't have surgery may receive radiation therapy or other treatment.

You may have a headache or be uncomfortable for the first few days after surgery. However, medicine can usually control pain. Before surgery, you should discuss the plan for pain relief with your health care team. After surgery, your team can adjust the plan if you need more relief.You may also feel tired or weak. The time it takes to heal after surgery is different for everyone. You will probably spend a few days in the hospital.Other, less common problems may occur after surgery for a brain tumor. The brain may swell or fluid may build up within the skull. The health care team will monitor you for signs of swelling or fluid buildup. You may receive steroids to help relieve swelling. A second surgery may be needed to drain the fluid. The surgeon may place a long, thin tube (shunt) in a ventricle of the brain. (For some people, the shunt is placed before performing surgery on the brain tumor.) The tube is threaded under the skin to another part of the body, usually the abdomen. Excess fluid is carried from the brain and drained into the abdomen. Sometimes the fluid is drained into the heart instead.

Infection is another problem that may develop after surgery. If this happens, the health care team will give you an antibiotic.

Brain surgery may harm normal tissue. Brain damage can be a serious problem. It can cause problems with thinking, seeing, or speaking. It can also cause personality changes or seizures. Most of these problems lessen or disappear with time. But sometimes damage to the brain is permanent. You may need physical therapy, speech therapy, or occupational therapy. See the Rehabilitation section.

BRAIN TUMORS DIAGNOSED

If you have symptoms that suggest a brain tumor, your doctor will give you a physical exam and ask about your personal and family health history. You may have one or more of the following tests:

MRI: A large machine with a strong magnet linked to a computer is used to make detailed pictures of areas inside your head. Sometimes a special dye (contrast material) is injected into a blood vessel in your arm or hand to help show differences in the tissues of the brain. The pictures can show abnormal areas, such as a tumor.

CT SCAN: An x-ray machine linked to a computer takes a series of detailed pictures of your head. You may receive contrast material by injection into a blood vessel in your arm or hand. The contrast material makes abnormal areas easier to see. Your doctor may ask for other tests:

RISK FACTORS FOR BRAIN TUMORS

Studies have found the following risk factors for brain tumors:

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Ionizing radiation: Ionizing radiation from high dose x-rays and other sources can cause cell damage that leads to a tumor. People exposed to ionizing radiation may have an increased risk of a brain tumor, such as meningioma or glioma.

Family history: It is rare for brain tumors to run in a family. Only a very small number of families have several members with brain tumors.

Researchers are studying whether using cell phones or having been exposed to certain chemicals at work or to magnetic fields are important risk factors. Studies have not shown consistent links between these possible risk factors and brain tumors, but additional research is needed.

SYMPTOMS OF A BRAIN TUMOR

The symptoms of a brain tumor depend on tumor size, type, and location. Symptoms may be caused when a tumor presses on a nerve or harms a part of the brain. Also, they may be caused when a tumor blocks the fluid that flows through and around the brain, or when the brain swells because of the buildup of fluid.

These are the most common symptoms of brain tumors:

Headaches (usually worse in the morning
Changes in speech, vision, or hearing
Problems balancing or walking
Changes in mood, personality, or ability to concentrate
Problems with memory
Muscle jerking or twitching (seizures or convulsions)
Numbness or tingling in the arms or legs

REVIEW PAPERS ON BRAIN CLASSIFICATION TECHNIQUES

The important process in the automated system is brain image classification. The main objective of this step is to differentiate the different abnormal brain images based on the optimal feature set. Several conventional classifiers are available for categorization but most of the earlier works depend on Artificial Intelligence (AI) techniques which yield highly accurate results than the conventional classifiers. The usage of Artificial Neural Networks (ANN) to improve the accuracy of the classifiers is illustrated by [4].This report was based on head and neck carcinoma detection and a comparative analysis was performed with the Linear Discriminant Classifier (LDA) to show the superior nature of neural networks. An interactive tool to classify the healthy and the tumorous MR brain images is proposed by [5]. But the accuracy proposed in this system is very low compared to the AI techniques. Though this approach claimed a faster convergence rate, it may not be much useful because of its low accuracy.

Support Vector Machine based classification of various levels of MR glioma images is performed by [8]. This method claimed to be better than rule based systems but the accuracy reported in the paper is low. This work dealt with only glioma images and thus the lack of generalizing capability of this work is another drawback of this sytem. The application of Kohonen neural networks for image classification is explored by [9]. Some modifications of the conventional Kohonen neural network are also implemented in this work which proved to be much superior to the conventional neural networks. A hybrid approach such as combination of wavelets and Support Vector Machine (SVM) for classifying the abnormal and the normal images is used by [10]. This report revealed that the hybrid SVM is better than the Kohonen neural networks in terms of performance measures. But the major drawback of this system is the small size of the dataset used for implementation. The different grades of abnormal images are categorized using artificial neural networks by [14]. This report suggested a practical method for selection of database. The training of ANN is dependent on input data and hence a wide variety of pattern is desirable for high accuracy. This report also highlighted the difficulty in collecting a large dataset of different uncommon patterns and hence concluded that the automated system can be tested with the images of common abnormalities.

A time efficient neural network such as PNN is used by for pattern classification problems [59]. Emphasis was given for convergence time than the classification accuracy. The results concluded that the PNN is superior over conventional neural networks in terms of training time period. A computer aided system for discriminating the primary and secondary tumors is developed by [15]. Probabilistic Neural classifier is used in this work. Though the report records high classification accuracy, the size of the dataset is significantly small. Statistical classifiers are used for classifying different tumor types and one such work is reported by This classification is performed on proton Magnetic Resonance Spectroscopy images. A comparative analysis with neural classifier is also reported in this work. This report concluded that a combined statistical and neural classifier increased the accuracy to higher extent.

An enhanced ART neural network for classification applications is implemented by . This employed the GA approach to select the order of training patterns to enhance the classification performance. This experiment is conducted on various datasets. But the classification accuracy results are different for different datasets which is one of the drawbacks of this approach.

A self-organizing neural network based automated system for glioma detection is implemented by [5] . The main disadvantages of this system are the low classification accuracy and the lack of multiclass analysis. RBF kernel based SVM for brain tumor detection is used by [8] The results of SVM are compared with AdaBoost, a machine learning algorithm. Experimental results illustrated the superior nature of SVM over the other classifiers. Image classification based on fuzzy approach using the pattern discovery algorithm is demonstrated by[12] Experiments are conducted on various real-world datasets and the results concluded that the proposed algorithm yield good results when compared with the other classifiers. A hybrid approach for pattern classification is reported by The

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combination of SVM and fuzzy rules is experimented in this work. The results revealed that the proposed hybrid approach is accurate, fast and robust.

PROPOSED METHOD

Body is made of many cells. Each cell has specific duty. The cells growth in the body and are divided toreproduce other cells. These divisions are very vital for correct functions of the body. When each cell loses the ability of controlling its growth, these divisions is done with any limitation and tumor emerges. Tumors, their self, are divided to tow classes: benign and malignant. According to a statistical report published by the Central Brain Tumor Registry of the United States (*CBTRUS*), approximately 39,550 people were newly diagnosed with primary benign and primary malignant brain tumors in 2002 [1-3].

Images usually contain one or more type of noise and artifact. Pre-processing is done to remove seeds from images and increase contrast between normal and abnormal brain tissues. The method used here are Histogram equalization, using Median filter, using Un sharp mask, thresholding and using from Mean filter respectively for each image.

According to upon statistics, it is clear that medical imaging has strong function to increase the yield and accuracy of tumor diagnosis in short time. Medical imaging is divided to two classes of anatomical and physiological. The anatomical imaging contains *CT*, Ultrasound and *MRI*.

In this research paper we have proposed a new enhancement and isolation process applied on MRI images for classification of tumors in the image. In this process, the medical image is treated as an array of pixel data. First step of the process is to determine the dimension of the image and determine the middle position of image array. We then take a maximum difference threshold (MDT) value, which is constant threshold determine by observation. We start checking this value with the image data by horizontally scanning from left of the array to the right. If result of any subtraction is greater than the MDT, the array will be divided into two equal subsets along middle position and the first and last positions of the two subsets will be pushed to stack. Otherwise, the mode value of subset will be propagated to all other position after modifying value using uniform color quantization technique in color space breaking in sixteen level scales.

In Figure 1 one normal and abnormal input image has been showed and Figure 2 showed the surgery or figure 3 shown original mri image

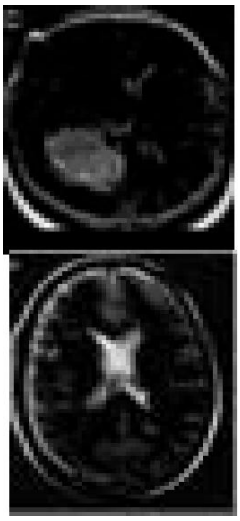

Figure 1: input image a) abnormal b) normal

Figure 2:during operation time brain

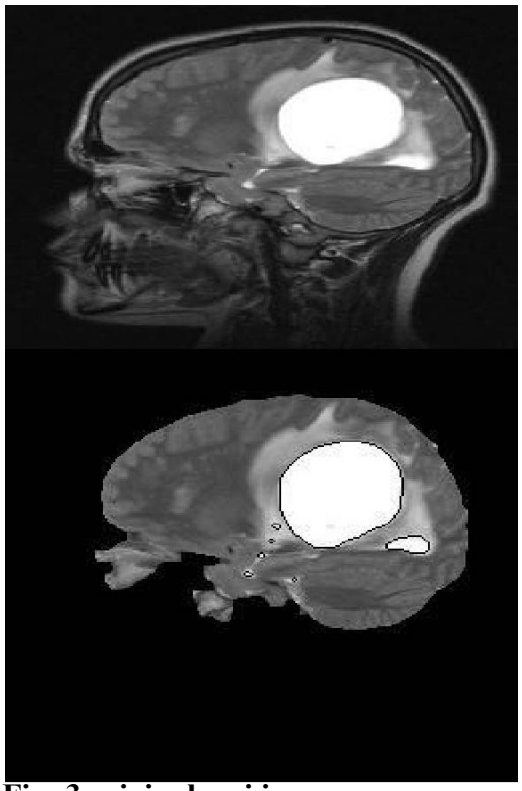

Fig -3 original mri image

CONCLUSION: Brain tumer early detection is very necessary because its surgery is very

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complicated if it find earlier by mri or ct scan ,or checked by doctor then you have to find the problem and with in time the patient be recovered earlier.

REFERENCES

[1] Ashby LS, Troester MM, "central nervous system tumors" cancer therapeutics, vol 1,pp.475-513,2006.

[2]cruickshank g , " tumours of brain surgery"oxford .22, pp. 69-72,2004.

[3].Doolittle ND, " State of The Science in Brain Tumor Classification", Semin Oncol Nurs, vol.20, pp.224-230, 2004.

[4] Ranald g , Stephen a , Kromhout- schiro s, Suresh k the role of neural networks in improving the accuracy of mr spectography for diagnosis of head and neck squamous cell carcinoma .ajnr 2000;21:1133-38.

[5] Michael r, Simon k , Peter m ,Ference a , "Automated segmentation of MRI images of brain tumer radiology 2000; 218: 586-91.

[6] Majos c, Julia-sape m, Juann j "Brain tumor classification by proton mr spectroscopy: comparison of te. Ajnr 2004: 25: 1 ,696-704.

[7] Li g, Yang j, Ye c, Geng d, "Degree prediction of malignancy of brain glomia using support vector,2004.

[8] .Messen W, Wehrens R, Buydens L. Supervised Kohonen networks forclassification problems. Chemometrics and Intelligent Laboratory Systems

[9] Chaplot S, Patnaik M, Jagannathan N. Classification of magnetic resonance brain images using wavelets as input to support vector machine anetwork.Biomedical [18] Signal Processing and Control 2006;1:86-92.

[10] .Yamashita K, Yoshiura T, Arimura H, Mihara F, Noguchi T, Hiwatashi A, Honda H. Performance evaluation of radiologists with artificial neural network for differential diagnosis of intra-axial cerebral tumors on MR images. AJNR 2008;29:1153-58.

[11].Ibrahiem M, Ramakrishnan S. On theapplication of various probabilistic neural networks in biomedicine -2009, pp-34-55.

[12].Egmont P, De D, Handels H. Image processing with neural networks-a review, 2009,pp-254-289.

[13] Selvaraj S, Thamaraiselvi S, Selvathi D, Gewali L. Brain MRI slices classification using least squares support vector machine. International journal of medical science in image processing 2007; pp-21-33.

[14] .Georgiadis P, Cavouras D, Kalatzis J, Daskalakis A, George C, Sifaki K, Ekaterini Solomou. Improving brain tumor characterization on MRI neural networks in biomedicine ,2005,pp-534-584.

[15] .Luts J, Heerschap A, Johan A, Huffel S. A combined MRI and MRSI based multiclass system for brain system, 2008, pp-540-584.

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