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BRAIN TUMOR DETECTION AND CLASSIFICATION

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***Abstract*:** The brain is the most important organ in the human body responsible for controlling and regulating all critical life functions for the body and a tumor is a mass of tissue formed by the accumulation of abnormal cells, which keep on growing. A brain tumor is a tumor which is either formed in the brain or has migrated. No primary cause has been identified for the formation of tumors in the brain till date. Though tumors in the brain are not very common (Worldwide brain tumors make up only 1.8% of total reported tumors), the mortality rate of malignant brain tumors is very high due to the fact that the tumor formation is in the most critical organ of the body. Hence, it is of utmost importance to accurately detect brain tumors at early stages to lower the mortality rate.

We have thus proposed a computer-assisted radiology system which will assess brain tumors from MRI scans for the management of brain tumor diagnosis. In this study, we have implemented a model that segments images using Watershed and PSO algorithm, extracts feature and finally classifies the tumors using algorithms with a high degree of accuracy.

Introduction :

The human body consists of a myriad number of cells. When cell growth becomes uncontrollable the extra mass of cell transforms into tumor. CT scans and MRI scans are used for identification of the tumor. The goal of our study is to accurately detect tumors in the brain and classify it through the means of several techniques involving medical image processing, pattern analysis, and computer vision for enhancement, segmentation and classification of brain diagnosis. This system can be used by neurosurgeons, radiologists and healthcare specialists. The system is expected to improve the sensitivity, specificity, and diagnostic efficiency of brain tumor screening using the industry standard simulation software tool, MATLAB. These techniques involve pre-processing of MRI scans collected from online cancer imaging archives as well as scans obtained from several pathology labs. Images are resized and then we apply the proposed algorithms for segmentation and classification. The system is expected to improve the brain tumor screening procedure currently in use, and possibly reduce health care costs by decreasing the need for follow- up procedures. Several processing steps are required for the accurate characterization and analysis of biomedical image data.

The cause of most brain tumors is unknown. Uncommon risk factors include exposure to vinyl chloride, Epstein–Barr virus, ionizing radiation, and inherited syndromes such as neurofibromatosis, tuberous sclerosis, and von Hippel-Lindau Disease. Studies on mobile phone exposure have not shown a clear risk. The most common types of primary tumors in adults are meningiomas (usually benign) and astrocytoma such as glioblastomas. In children, the most common type is malignant medulloblastoma. Diagnosis is usually by medical examination along with computed tomography (CT) or magnetic resonance imaging (MRI). The result is then often confirmed by a biopsy. Based on the findings, the tumors are divided into different grades of severity.

Treatment may include some combination of surgery, radiation therapy and chemotherapy. Since the brain is the body's only non-fungible organ, surgery carries a risk of the tumor returning. If seizures occur, anticonvulsant medication may be needed. Dexamethasone and furosemide are medications that may be used to decrease swelling around the tumor. Some tumors grow gradually, requiring only monitoring and possibly needing no further intervention.

Outcomes for malignant tumors vary considerably depending on the type of tumor and how far it has spread at diagnosis. Although benign tumors only grow in one area, they may still be life-threatening depending on their size and location. Malignant glioblastomas usually have very poor outcomes, while benign meningiomas usually have good outcomes. The average five-year survival rate for all (malignant) brain cancers in the United States is 33%. Secondary, or metastatic, brain tumors are about four times as common as primary brain tumors, with about half of metastases coming from lung cancer. Primary brain tumors occur in around 250,000 people (about half the population of Wyoming) a year globally and make up less than 2% of cancers. In children younger than 15, brain tumors are second only to acute lymphoblastic leukemia as the most common form of cancer. In NSW Australia in 2005, the average lifetime economic cost of a case of brain cancer was AU$1.9 million, the greatest of any type of cancer.

1. Literature review

In Medical diagnosis, robustness and accuracy of the prediction algorithms are very important, because the result is crucial for treatment of patients. There are many popular classifications and clustering algorithms used for prediction. The goal of clustering a medical image is to simplify the representation of an image into a meaningful image and make it easier to analyze. Several Clustering and Classification algorithms are aimed at enhancing the prediction accuracy of diagnosis process in detecting abnormalities.

The first section of this chapter presents different pre-processing techniques on the MRI Images obtained. The types of Segmentation algorithms used are given in the second section. The next section discusses the different feature extraction methods and finally the classification algorithms have been presented followed by the summary of this chapter. The main goal is to highlight advantages and limitations of these methods. Key image processing techniques for brain MRI image segmentation is classified as k-means, SVM, FCM, k-nearest neighbor, neural network, adaboost, genetic and other methods etc.

Parveen, Amritpal Singh purposed algorithm is a combination of SVM and fuzzy c-means, a hybrid technique for prediction of brain tumor. Here, the image is enhanced using contrast improvement, and mid-range stretch. Double thresholding and morphological operations are used for skull striping. Fuzzy c-means (FCM) clustering is used for the image segmentation. Grey level run length matrix (GLRLM) is used for extraction of feature. Then, Linear, Quadratic and Polynomial SVM technique is applied to classify the brain MRI images. Real data set of 120 patients MRI brain images have been used to detect 'tumor' and 'non-tumor' MRI images. The SVM classifier is trained using 96 brain MRI images, after that the remaining 24 brain MRI images was used for testing the trained SVM. SVM classifier with Linear, Quadratic and Polynomial kernel function give 91.66%, 83.33% and 87.50% accuracy respectively and 100% specificity.

Astina minz, Prof. Chandrakant Mahobiya proposed an effective automatic classification method for brain MRI is projected using the Adaboost machine learning algorithm. The proposed system consists of three parts such as Preprocessing, Feature extraction and Classification. Preprocessing has removed noise in the raw data, it transforms RGB image into grayscale, median filter and thresholding segmentation is applied. For feature extraction by using GLCM technique 22 features were extracted from an MRI. For classification boosting technique used (Adaboost). It gives 89.90% accuracy and result in normal brain or in Malignant or Benign type of tumor. In future work, we can work of quadratic and polynomial kernel function. The accuracy of the system will be increased by increasing training database images. Also the system can be implement for different types of classes like Glioma and Meningioma.

Methodology :

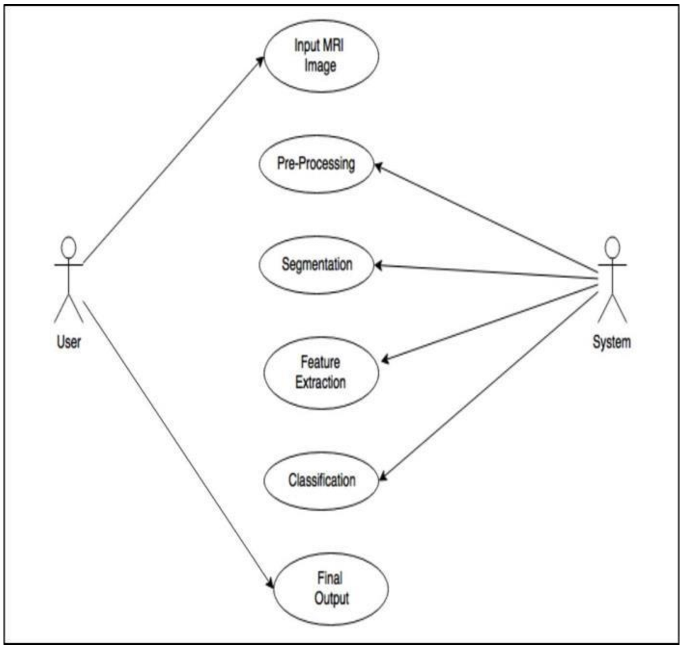

Fig 1: Flow chart

Input Image

The first and the most important step in the entire process is the collection of input images from the user, therefore the image should be processed to enhance the image quality. The figure 1 shows the image that is considered as input in this paper. Input acquired from the user is analyzed and the corresponding disease is identified. In order to achieve accurate results, the image is filtered.

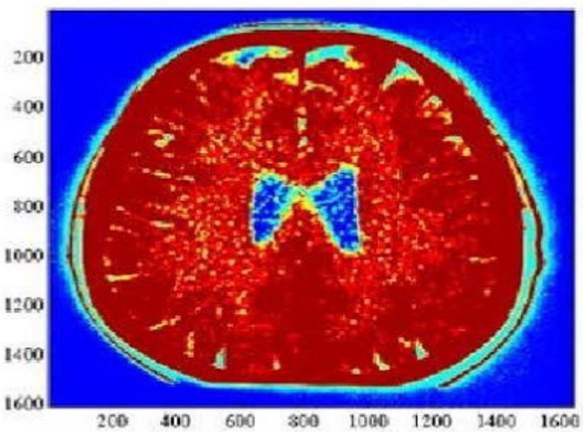

Fig 2: Input image

Pre-processing

In this step the input image is resized and then filtered in order to achieve high accuracy. The filtering process is done using an adaptive median filter to remove unwanted distortions such as noise. The input RGB image is then converted into a grayscale image in order to diminish the amount of information provided for each pixel [12], [1].

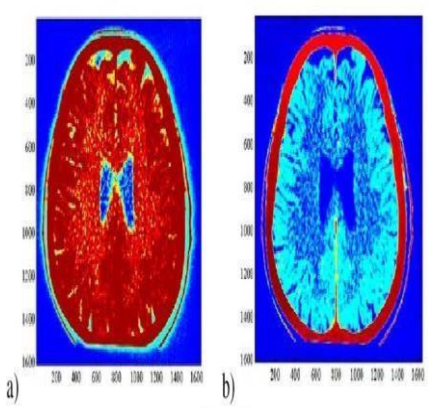

Fig 3: Pre-processing

Segmentation

The partition of an image into several parts is necessary in digital image processing and analysis of the image and a common technique used to achieve this is image segmentation which is based upon the pixel values and the pixel characteristics of the image. The image segmentation is done by separating the regions of contrast and by forming sets of pixels basing upon shape and colour. Image segmentation technique called thresholding is used to identify those tissue types in the images. Thresholding is a method to separate groups of objects in a scene.

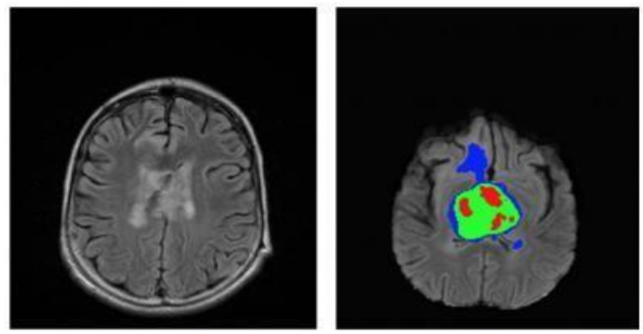

Fig 4: Segmentation

Feature extraction

In this step the features of the segmented images are extracted, these features represent the relevant information of the image, thereby reducing the amount of information to be processed. In image processing feature extraction is essential in pattern recognition and in reducing the data to be processed by the classifier. Feature extraction is performed using GLCM(Gray Level Cooccurrence Matrix) [12]. This method uses a statistical method of texture analysis which uses spatial relationships of pixels in the gray-level co-occurrence matrix (GLCM) [9], which is also known as the gray-level spatial dependence matrix. The features such as autocorrelation, entropy, homogeneity and energy [10].

Classification

The features extracted are given as an input to the classifier. The classifier used in this paper is RBF Accuracy, linear Accuracy, Polygonal Accuracy and Quadratic Accuracy.

Radial basis function (RBF) is a type of artificial neural network (ANN) that has been used in brain tumor detection with varying degrees of accuracy. The accuracy of RBF-based brain tumor detection depends on several factors, including the quality and quantity of the input data, the choice of parameters such as the number of hidden neurons and the spread of the RBF function, and the training algorithm used to optimize the network.

The term "linear accuracy" is not a commonly used term in the field of medical imaging or brain tumor detection.

In general, accuracy in medical imaging refers to the ability of a system to correctly identify a condition or abnormality. This can be measured by various metrics such as sensitivity, specificity, positive predictive value, negative predictive value, and accuracy. Quadratic accuracy is not a commonly used term in the context of brain tumor detection and classification. However, in machine learning, accuracy is often used to measure the performance of a model in predicting the correct class or label for a given input.

In the case of brain tumor detection and classification, a common approach is to use medical imaging techniques such as magnetic resonance imaging (MRI) to obtain images of the brain, and then use machine learning algorithms to analyze these images and identify the presence of tumors.

VI. RESULT

The output, that is the identified Brain Tumor in the GUI (Graphical User Interface) under the classification button. The GUI has several fields that provide additional information such as entropy, area percentage of the spread of the disease which is calculated based upon the input image.

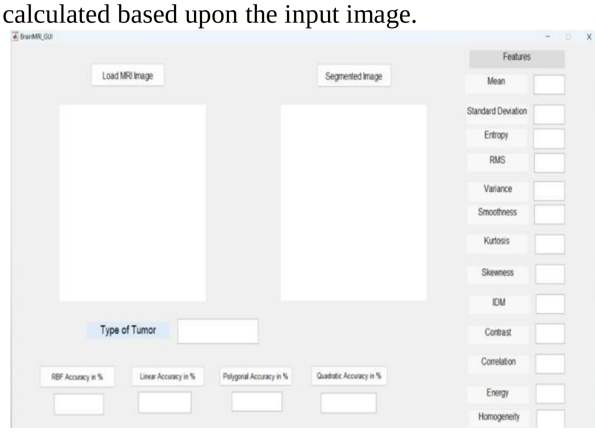

Fig 5: User interface

Fig 6: Extracted Features of Malignant

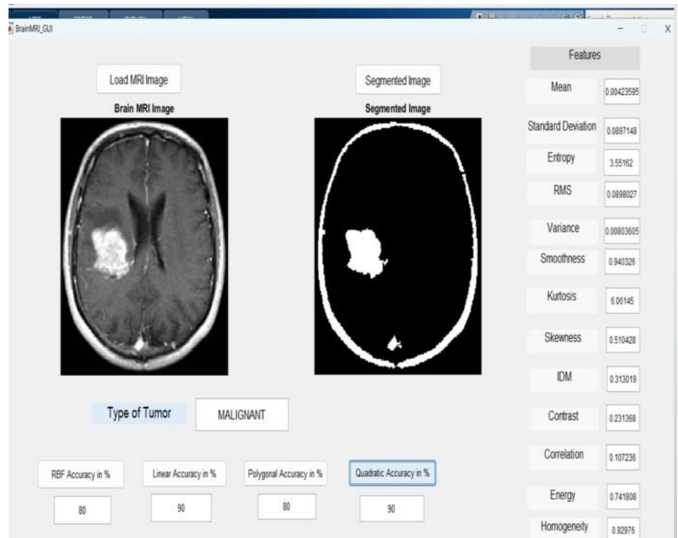

Fig 7: Classified Output of Malignant

Advantages

It is very difficult for doctors to detect a brain tumor at an early stage. MRI images are more susceptible to noise and other environmental Disturbances. Therefore, it becomes difficult for doctors to determine the tumor and its causes. So, we came up with a system in which the System will detect a brain tumor from images.

Conclusion

Abnormal growth of tissue in the brain which affect the normal functioning of the brain is considered a brain tumor. The main goal of medical image processing is to identify accurate and meaningful information using algorithms with minimum error possible. Brain tumor detection and classification through MRI images can be categorized into four different sections: pre-processing, image segmentation, feature extraction and image classification. Various segmentation methodologies are explored in the project. It can be concluded that the algorithms and the parameters used in the proposed system are all meant to increase the efficiency of the system by achieving better results. The boundary approach and the edge-based approach for segmentation are very common but the region growing approach gives better results. It is found that the particle swarm optimization algorithm gives the most accurately segmented tumors. Features extracted by using different methods help to increase efficiency as minute details of tumor by using various features can be extracted. Of the various classification methods studied, it was experimentally found that the convolution neural networks give the best classification accuracy. Accuracy and reliability are of utmost importance in tumor diagnosis, as a patient's life depends on the results predicted by the system. Thus, the proposed methodology helps in increasing the accuracy and obtaining the desired results.

In this paper we have project a partial survey of various classification techniques for MRI brain image as well their advantages and disadvantages. A comparative study is made on various techniques.

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