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Fuzzy-Transform based early detection of brain tumor

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Abstract: Early detection of brain tumor is intricate job as well as tumor segmentation studies based on MRI imaging are attracting more and more attention in recent years. For detection of unusual growth of tissues and block of blood in nervous system can be seen in an MRI image. The first step of detection of brain tumor is to check symmetric and asymmetric shape of human brain which will define the abnormality. After this step next step is segmentation based on two techniques. 1) Fuzzy transform 2) Morphological operations. These operations are performed to delineating brain tumor boundaries and calculate the area of tumor. The F-Transform is a professional intelligent method to handle uncertain information and to extract salient edges.

Keywords: MRI image segmentation, brain tumor, fuzzy transform, morphological operation.

1. Introduction:

Medical image processing is the greatest challenging and developing field. Now a day's processing of MRI images is one of the parts of this field. The measureable analysis of MRI brain tumor allows obtaining valuable key indicators of disease progression. Brain tumors are defined as the unusual growth of the tissues.

Brain tumors can be either primary or secondary. Primary tumors are composed of cells just like those that belong to the organ or tissue where they start. Tumors can disturb any part of the brain and subject on what parts of the brain it distresses can muscle movement. Brain tumors are classified into Gliomas, Medulloblastoma, Ependymomas, CNS Lymphoma and Oligodendroglioma. Gliomas are the most frequent primary brain tumors in adults and account for 70% of adult malignant primary brain tumors.

2. Relevance:

Brain tumors are the leading cause of childhood cancer deaths. Detection of Brain tumor at an early stage might permit life-saving intervention. Clinical and preclinical diagnosis and evaluation of Brain cancers involve several imaging technologies including magnetic resonance imaging (MRI), Positron emission tomography (PET), and Computed tomography (CT), Ultrasound (US). Brain tumor might influence any individual at any age, and its impact on the body may not be the same for every individual. Brain tumor can affect individuals at any age. The impact on every individual may not be same. Due to such a complex structure of human brain, a diagnosis of tumor area in brain is challenging task.

3. Literature Review:

3.1. Automated Segmentation and Detection of Brain Tumor from MRI

In this paper [1], author proposed method used for segmentation of brain tumors in MRI images based on convolutional neural networks. For cancer diagnosis the brain tumors segmentation is done manually, from MRI images having large amount of data generated in clinical routine which results in time task. It suggests using convolution neural networks (CNN) method for segmentation of brain tumors in MRI images. The magnetic resonance imaging (MRI) images are used in medical imaging technique, to provide detailed information about the internal tissue of respective image.

In the diagnosis of brain tumor, determination of the exact location is an important task which helps to find out the shape & size of tumor. In brain tumor detection techniques, image segmentation plays a energetic role. In order to extract tumor from MRI images of brain different image segmentation techniques are used For the reason that segmentation of MRI provides the detailed information about the soft brain tissues such as gray matter (GM), white matter (WM), cerebral spinal fluid (CSF) etc.[9]. There are two types of segmentation includes a manual segmentation and automatic segmentation.

3.2. MRI Brain Tumor Detection using cuckoo Search Support Vector Machines and Particle Swarm Optimization Based Feature Selection

In this paper [2], author proposed system for automated diagnosis, on basis of classification of Magnetic Resonance Imaging (MRI) human brain images. Wavelet Transform is utilized for feature extraction. For feature selection Particle Swarm Optimization (PSO) is applied to decrease features size. To optimize support vector machine (SVM) parameters author utilize Cuckoo Search and Support Vector Machine (CS-SVM) model. SVM is applied to create the classifier.

3.3. Detection and classification of HGG and LGG Brain Tumor using Machine Learning

The proposed system [3] is designed for the precise detection and classification of normal and abnormal brain MRI's and then the classification of the abnormal MRI's into HGG or LGG glioma tumor.

Brain MRI is read by the system, and then Otsu binarization is applied to convert the image into a binary image. After that k-means clustering is applied for segmentation. Later, DWT and PCA are applied. Finally, SVM [4] is used for classification. In stage 1, the images are classified into normal or abnormal MRI's. In stage 2, the abnormal MRI images are classified into HGG or LGG glioma tumor MRI.

3.4. Application of ANN and ANFIS for detection of brain tumor using DWT and GLCM texture analysis

In this work author combine different methodologies in order to develop algorithms for Computer-Aided Diagnosis(CAD) for brain tumors from the axial plane . All methods utilize texture analysis by extracting features from raw data, without post-processing, based on different techniques, such as Gray Level Co-Occurrence Matrix (GLCM), or Discrete Wavelet Transform (DWT) and different classification methods, based on ANN or ANFIS. All of proposed methodologies are developed, validated and verified on various sub data including 65% non-healthy MRIS. The total used database consists of 202 MRIs from non-healthy patients and 18 from healthy, segmented visually by an experienced neurosurgeon. Combining different subsets of features, our best results are by using 4 GLCM features for a input and two hidden layers ANN, giving sensitivity 100%, specificity 77.8% accuracy 94.3%. It is proved that the input data to train such a CAD are considered to be unbiased if the ratio between healthy/un-healthy tissue MRIs is about 35%/65%, respectively [4].

3.5. Arithmetic Neural Network

A neural network is a powerful computational data model that is able to capture and represent complex input/output relationships. And also it is provides powerful tool to help doctors to analyze, model and make sense of complex clinical data across a broad range of medical image applications[6]. Most applications of ANNs in medicine are classification problems such as pattern recognition; that is, the task is on the basis of the measured features to assign the patient to one of a small set of classes. [7].

The proposed methods that were used for this study were summarized in three phases: First phase is preprocessing of MRI images Second phase is post processing of images like segmentation, morphological operations, feature extraction, etc. final phase is implement the feature of images for pattern recognition to detect the tumor.

3.6. Hybrid Approach for detection and segmentation using artificial BEE colony Optimization with FCM

In this paper [10], author proposed a system to recognize the tumor in the favorable stage. The clearness - Hence, the Fuzzy-C-Means (FCM) bunching is consolidated alongside Ant Colony Optimization, the FCM which aggregate the pixels of the tumor district into gatherings/groups. Arrangement is finished utilizing the improvement method so the time calculation is lessened.

3.7. An Efficient Brain Tumor Detection System using Fuzzy Clustering & Neural Network:

In this paper, author proposed method using fuzzy C-means clustering algorithm along with self-organizing MAP neural network along with thresholding and morphology for proper classification of medical data. Firstly, the work was carried over to calculate the area of the tumor of single slice of MRI data set and then it was extended to calculate the area of the tumor from multiple image MRI data sets.

4. Proposed Work

This work "F-Transform based early detection of brain tumor "proposes an algorithm for the early detection of brain tumor. This system provides an efficient way for diagnosis of the brain tumor. Proposed system consists of multiple phases.

4.1. Objectives:

- Objectives of proposed work are as follows:
- This work is proposed to enhance the accuracy and reduce computational problems in already proposed algorithms.
- The main purpose using F-transform is to control the amount of details appears in edge image and suppresses noise
- It enhances the efficiency of system.

4.2. Scope:

The brain tumor segmentation studies based on MRI are attracting more and more attention in recent years due to noninvasive imaging and good soft tissue contrast. Also it describes the proposed approach for detection and extraction brain tumor from MRI scan images of brain.

The overview of proposed system is shown in Flow Dia.

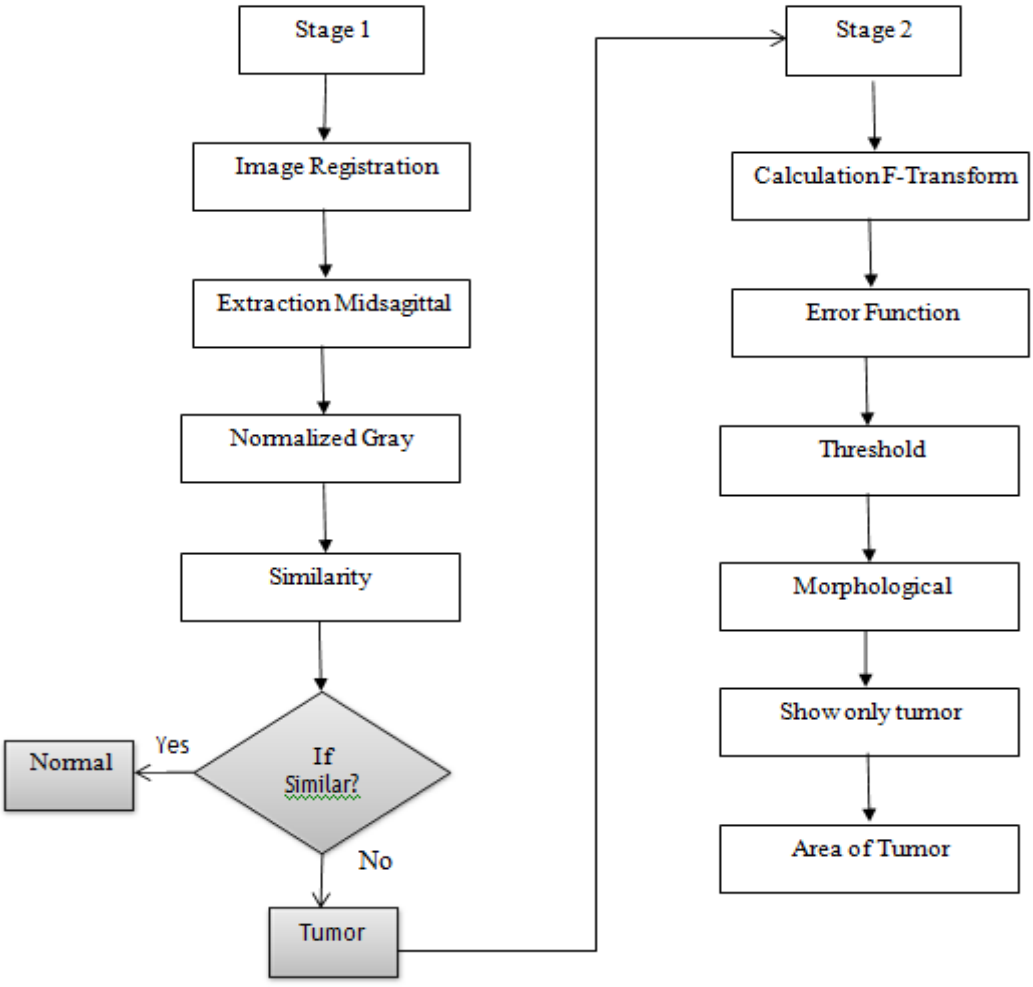

Fig. Flow Diagram of proposed work

4.3. Methodology:

Selecting an appropriate, proven methodology is important step in any research endeavor. To evaluate the performance of proposed work we will design a simulation model. The design steps in simulation model are as below:

4.3.1 Stage-I

- Image registration -To insure that brain image in the middle. If not then image alignment operation performed to get brain image in middle.

- Extraction midsagittal - This technique used to separate brain into left and right hemispheres. By this technique human brain is divided into two equal left and right parts.
- Normalized Gray - In this the normalized gray level histograms of left and right hemispheres is calculated.
- Similarity measures – By using five symmetry measures i.e. 2-D correlation, Root Mean Square Error (RMSE), Average Gradient (AV), Entropy, Variance Distance the similarity between two parts is calculated.
- After analyzing above five parameters, judge the data as normal or with suspicious tumors according to quantified similarity value of each symmetry measure.
- The degree of asymmetry will be carefully considered as indication of pathology.

4.3.2 Stage-II

- Calculation of F-transform - Calculate F[u] the direct F-transform of image and Calculate unn – the inverse F-transform using the components F[u].
- Error Function - Calculate the error function Rescale and round the values of e.
- Compute the threshold value of segmentation purpose.
- Morphology – After applying threshold we have to apply morphology to get tumor area.
- Show only tumor area by square and remove all other components.
- Area of tumor is calculated by using horizontal dimension and vertical dimension

4.3.3 Stage-III

- Performance Evaluation Parameters
  1) Accuracy – To calculate accuracy we need to examine algorithm on at least ten images then collectively claim the accuracy.
  2) Precision – Same thing about precision we need to examine more than ten images to calculate precision.

4.3.4 Stage IV

- Performance of proposed work is validated with real time images.

5. Conclusion:

This paper discusses, Brain tumor detection using segmentation based of fuzzy transform. F transform model capture the silent edges. The speed of detection is improved using asymmetry of brain. The primitive techniques are based on manual segmentation which is time consuming process. his algorithm can be used to process large brain images with its high speed and good sensitivity.

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