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Diagnosis of brain tumorby using digital image processing technique

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Abstract

In this paper we propose algorithm for the diagnosis of brain tumor in both cases normal or abnormal tumor, it has been the use of neural network technology after making optimizations, filter and remove the impurities of the brain image. Samples were taken from a group of patients in AL-Husain Teaching Hospitaldisparate ages and both gender, there are 100 images collected 80 of them training which showed the results of 100% and 20 of these samples were tested results showed 90%.

Keywords: brain tumor;preprocessing;brainsegmentation; feature extraction; diagnosis

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تشخيص اورام الدماغ بأستخدام تقنيات معالجة الصور الرقمية

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الخلاصة

تتسارع الخطى في مجال التقدم العلمي و الذي ينصب في مجال خدمة الانسان بتوفير متطلباته اليومية الصحية و الخدمية . يعد الجانب الصحي هو واحد من اهم المحاور التي يسعى العلم الى البحث فيها لأن لها تأثير مباشر على وجود الانسان.

أن الغرض من هذه الرسالة هو اكتشاف وسيلة للكشف عن الدماغ سواء ان كان طبيعيا أو غير طبيعي (يحتوي على ورم) باستخدام تقنية الشبكة العصبية وتم تنفيذه من خلال عدة مراحل. المرحلة الاولى من نظام تشخيص اورام الدماغ هي ادخال الصورة إلى النظام كبيانات رقمية. و تكون المعالجة هي المرحلة الثانية التيتشم لا لحد من الضوضاء وإزالة شوائب من صورة الدماغ بحيث يتم إزالة الضوضاء بأستخدام المرشح الوسيط .بعد المعالجة يتم تجزئة الصورة تجزئة الصورة ، تجزئة الصورة وهي عملية تقسيم الصورة الرقمية المستخدمة لتسهيل التحليل و تعتبر مرحلة أساسية في مجال معالجة الصور ورؤية الكمبيوتر. و ان استخلاص الميزات هي التقنية او المرحلة التي تستخدم لقياس الخصائص المختلفة لأجزاء الصورة تعطى الخصائص المحددة كمدخلات للشبكة العصبية .تصنف قواعد البيانات وفقا الى نوعين من صور الدماغ (طبيعي و غير طبيعي)

1- Introduction

Brain tumor is one of the most dangerous diseases which require early and accurately detection methods, current used detection and diagnosis methods for image evaluation depend on decision of neuro-specialists, and radiologist which possible to human errors. Manual classification of brain tumor is time consuming. This paper describes the processes and techniques used in detecting brain tumor from magnetic resonance imaging (MRI) and ANN techniques, which are of the most application of artificial intelligent that used in biomedical image classification andrecognition.There are three stages the first stage starting by using threshold to segment the MRI images,in the second stage statistical feature analysis was used to extract features from MRI images.The suitable and best features are used to detect the tumor in image were selected. In the third stage the artificial neural network (ANN) is a computational model that attempts to account for the parallel nature of the human brain. An (ANN) is a network of highly interconnecting processing elements (neurons) operating in parallel. These elements are inspired by biological nervous systems. As in nature, the connections between elements largely determine the network function. A subgroup of processing element is called a layer in the network. The first layer is the input layer and the last layer is the output layer. Between the input and output layer, there may be additional layer(s) of units, called hidden layer(s) [1].The weights in an ANN express the relative strengths (or mathematical values) of the various connections that transfer data from layer to layer. In other words, the weights express the relative importance of each input to a Processing element [2][3].the feed- forward back propagation neural network with supervised learning were apply as automatic method to classify the images under investigation into tumor or non-tumor . The network performances were evaluated successfully tested and achieved best results. This paper proposes a system for the diagnosis of brain tumor [4].

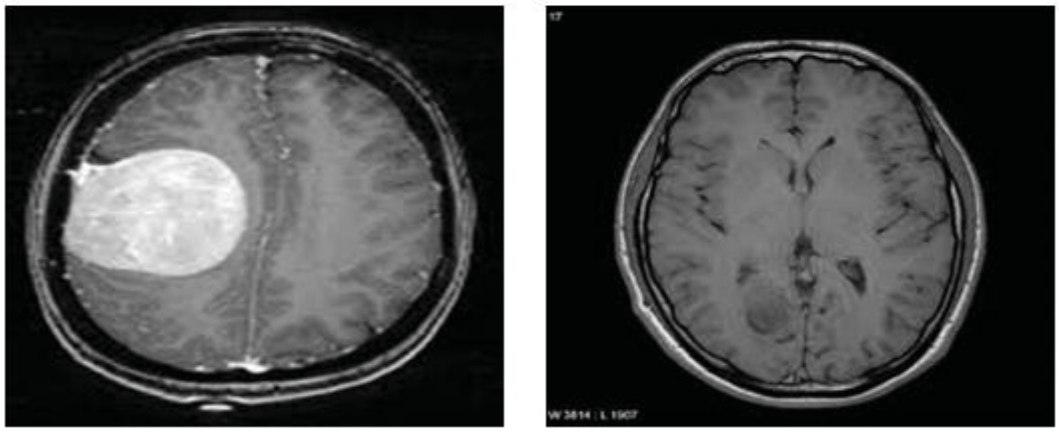

Fig (1):brain image. (a) Abnormal. (b) Normal.

2. Relatedworks

1. **In 2005, Ing. AleˇsProch´azka [33],** the use of image defragmentation by turning point conversion and wavelet-basedextraction feature to classify picture textures by methods. These competitive neural network used for brain classification and fragmentation.
2. **In 2011, R.B. Dubeyet. al. [37],** used a comparison of three different semi-automated methods, modified gradient magnitude region growing technique (MGRRGT), level set and a marker controlled watershed method is undertaken here for evaluating their relative performance in the segmentation of tumor.
3. **In 2011, N. S. Zulpeet. al. [40],** used a semiautomatic segmentation method to extract the tumor from MRI scan and measure the exact area of the brain tumor by using statistical approach.
4. **In 2015, HussnaElnoor Mohammed Abdalla**, Brain Tumor Detection by Using Artificial Neural Network. This study describes the processes and techniques used in detecting brain tumor from magnetic resonance imaging (MRI) and ANN techniques, the network performances were evaluated successfully tested and achieved best results with accuracy of 90%.

3.The Proposed algorithms

This section gives an overview of the proposed algorithm for the diagnosis of brain tumor.The proposed structure of the system in Figure 2.

Step1: Input image

Images obtained or used should be of MRI scans and these scanned images are displayed in a two dimensional matrices which will have the number of pixels as its elements. Images are stored in Matlab and converted (if not already) to be displayed as a gray scale image of size 256*256. The size is important to reduce processing time or to be large enough to be considered for proper processing.

Step2: Preprocessing

Atfirstit'snecessarytoapplyseveralpre-processingstepstotheoriginalbrainimage toproduceconsistentconditioninallimagetobeusedinfeaturesextractionprocedure. In this step, the brain is processed prior to feature extraction in order to eliminate noise and to enhance the features used in the next steps.

MedianFilter

It performs median filtering of the matrix A in two dimensions. Each output pixel contains the median value in the 3 by-3 neighborhood around the corresponding pixel in the input image filter.Can be expressed as follows [5] [6]:

$$B\ (n,m)\ =\ med\ \{A\ (i,j),(i,j)\ \in T \qquad (1)$$

Step3: Segmentation

The Image segmentation is an essential task in the fields of image processing and computer vision. It is a process of partitioning the digital images and is used to locate the boundaries into a finite number of meaning full regions and easier to analyze.

Threshold based segmentation

Thresholding is a standard method for image segmentation, which separates an object from its background by specifying a threshold value.

Identifying the Seed Point Coordinates

As the MRI is converted into binary form, and to proceed forward in the process of extracting the brain tissue, must be sure that the candidate seed point lies within the binary region of the brain's tissue. In this work, the coordinates of the seed point is selected (automatically).

Extracting the Brain Tissues

As the coordinates of the seed point is specified, we can now move from this point toward the image frame in a radial-circular shape and stopping only when we encounter by a pixel of zero value (i.e. the tissue's border)

Step4: Feature extraction

Techniquesby using the contrast and the standard deviation, Energy, Correlation,Inertia, Entropy and Inverse Difference Moment,which given the specific features as input to the neural network classified (NN). Seeded classified databases due to the two type of brain image, (normal or abnormal) [7][8].

4. Segmentation:

The simplest method for image segmentation is thresholding, by which the processed image is converted into binary form whose gray level values are either"0" (black) or "1" (white). For a grey tone image, "Th" is a positive real number in the range of [0, K], Where K is real number. So, thresholding may be viewed as an operation that involves tests against a value "Th ". The segmentation procedure is represented by the following equation:

$$Bin(x, y) = \begin{cases} 1 & \text{if } MRI(x, y) \geq Th \\ 0 & \text{Otherwise} \end{cases} . \quad (2)$$

At present work we have developed a simple way to determine the optimum value of the threshold; i.e. the optimum threshold value is defined as the gray level of lowest probability (i.e. of lowest probability) located between two highest peaks (i.e. of highest probability values) in the image histogram.

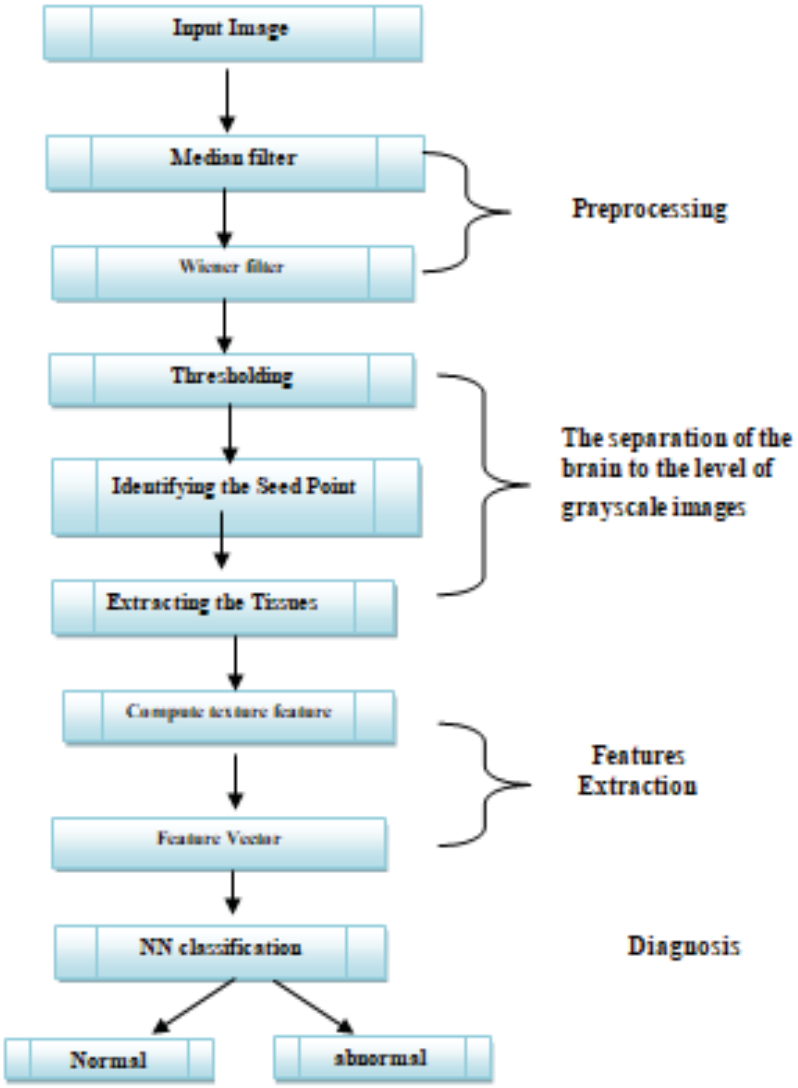

Fig (2): Main Block diagram of the proposed approach

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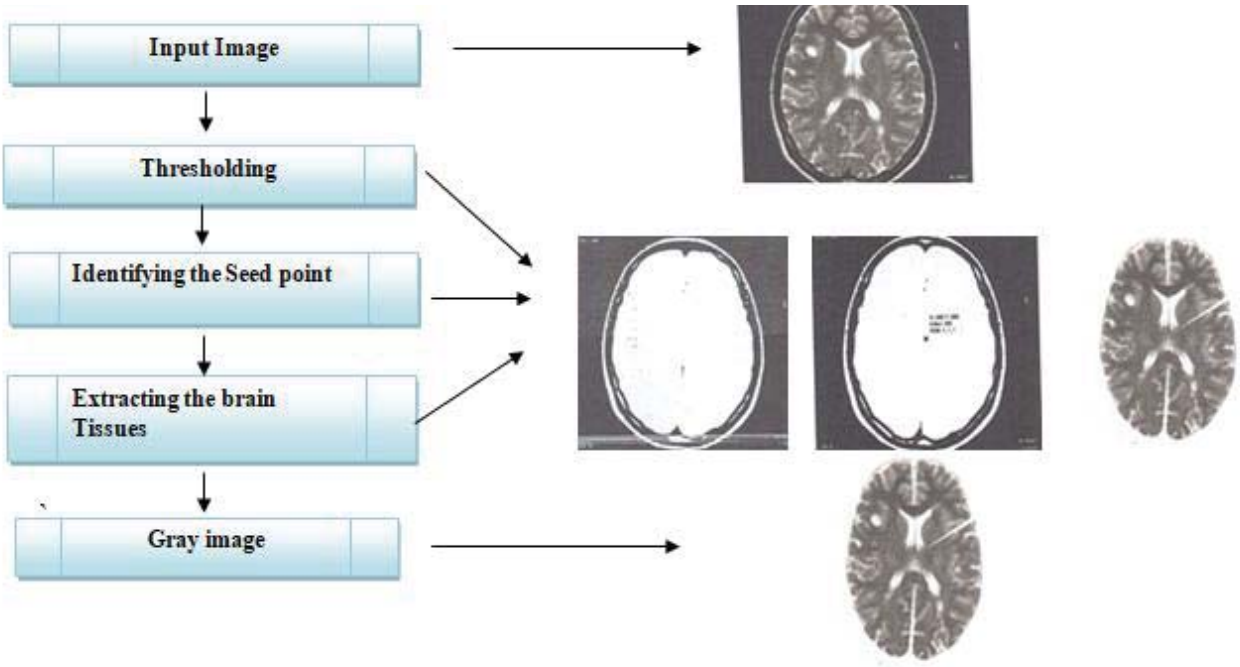

Fig (3): The main segmentation steps

5.Artificial neural networkdesign:

Afterfeaturesextraction,wedividedthesamplesintotwogroups.Thefirstgroupis used to learn ANN (training phase). The second group is used to calculate or test the efficiency of the ANN to distinguish different samples from that used in the learning phase (testing phase).

ANN design includes two things:

1. Network structure: Number of neurons in the input and output layers and in the hiddenlayer
2. Network settings: Include initial weight, learning rate and number ofepoch.

MLP-ANN was used for the brain tumor detection. The initial parameters of the neural networks used in these tests are given below:

Type: Feed forward back propagation network.

Number of layers: 3 (input, one hidden, output layer).

- Number of neurons in input layer: Number of features extraction from brain image=10
- Number of neurons in hidden layer : 20
- Number of neurons in output layer : 1
- function of the layer: sigmoid function
- Number of epochs used in training: 1000
- Backprop weight:[0.4,-0.4]

For the most part, a network is trained by changing the weights of the connections between nodes .These weights can be randomly chosen or individually chosen. A program randomly generates

values for connection weights. Then, the network is given an input, and it is allowed to process the information through its nodes to produce an output.

6. Experimental and Results

Eightydataset MRI brain images taken from AL-Husain Teaching Hospital.(Forty for normal and forty abnormal) were given as inputs to the neural network for classification, we trained NN using known datasets and desired outputs. The classifier classifies the given datasets into normal and abnormal. The obtained results from training are 100%. When we test the NN on twenty cases (ten for normal and ten for abnormal), we found that two of these cases fail in testing (one for normal case and one abnormal case). So the accuracy of the system is 90%.

Tables (4.1)show the classification results from NN classifier.

Performance Parameters	Performance%
True Positive rate	90.0
False Positive rate	10.0
True Negative rate	90.0
False Negative rate	10.0
Sensitivity	90
Specificity	90
Accuracy	90

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