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Neural network Base Feature Extraction and Classification in Brain Cancer MRI

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***Abstract* – Brain tumor is one of the major causes of death among people. It is evidence that the chances of survival can be increased if the tumor is detected correctly at its early stage. Detection of these tumors from brain is very difficult at the regions where a tumor is overlapped with dense brain tissues. Visually detection of these abnormal tissues may result in misdiagnosis of volume and location of unwanted tissues due to human errors caused by visual fatigue. In this paper we design cancer recognition system for the classification and estimation of cancer affect on given MRI image. To evaluate the performance of classification rate and the efficiency for the implemented automated recognition system.**

***Keywords* – MRI, ANN, GLCM, Thresholding, Binarization, Feature Extraction.**

I. INTRODUCTION

For the brain Cancer Detection and Classification System uses computer based procedures to detect tumor blocks or lesions and classify the type of tumor using Artificial Neural Network in MRI images of different patients with Astrocytoma type of brain tumors. The image processing techniques developed for detection of the brain tumor in the MRI images of the cancer affected patients is classified into 6 major parts as Histogram Equalization, Binarization, Morphological Operations, Region Isolation, Feature Extraction, Classification. The extraction of texture features in the detected tumor has been achieved by using Gray Level Co-occurrence Matrix (GLCM). These features are compared with the stored features in the Knowledge Base. We can applied this process on a clustered database consisting of 60 distinct MRI images categorized into 4 classes. For the automated recognition of tumor cell in given MRI image a neuro classifier is realized. The classifier module implements a backpropagation algorithm integrating neural network. Neural approach found to have more accurate decision making as compare to their counterparts. The obtained features are processed before passing it to neural network.

II. ARTIFICIAL NEURAL NETWORKS APPROACH IN DIAGNOSTIC PROCESS

Artificial Neural Networks (ANN) are nonlinear information processing devices, built from interconnected elementary processing devices called neurons inspired by the way biological nervous systems. The development of the ANN started in 1943 by McCulloch and Pitts and is still growing extravagantly. An artificial neural network (ANN), usually called neural network (NN), is a mathematical model or computational model that is inspired by the structure and/or functional aspects of biological neural networks. A neural network consists of an interconnected group of artificial neurons, and it processes information using a connectionist approach to computation. In most cases an ANN is an adaptive system that changes its structure based on external or internal information that flows through the network during the learning phase. Modern neural networks are linear statistical data modeling tools. They are usually used to model complex relationships between inputs and outputs or to find patterns in data. The advantages of ANN include adaptive learning, self organization, parallelism, fault tolerance etc., Applications involve in knowledge extraction, pattern recognition, forecasting, clinical diagnosis, security systems and still wider. In this paper, survey is made on applications of Neural Networks to diagnostic science. The following subsections discuss on how ANN is utilized for image classification over generations.

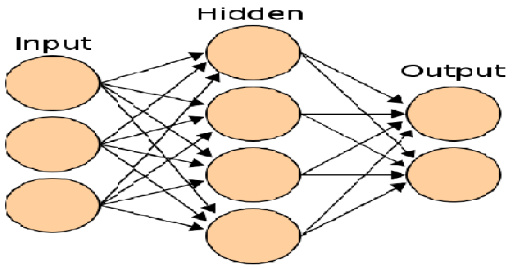

Fig.1. Architecture of Artificial Neural Network

III. METHODOLOGY USE

The designed system works in two phases namely Learning/Training Phase and Recognition/Testing Phase. In Learning/Training Phase the ANN is trained for recognition of different Astrocytoma types of brain cancer. The known MRI images are first processed through various image processing steps such as Histogram Equalization, Thresholding, and Sharpening Filter etc. and then textural features are extracted using Gray Level Co-occurrence Matrix. The main problem in the process is that the tumor appears very dark on the MRI image which is very confusing in the edge detection process. To overcome this problem, two steps were performed. First, histogram equalization has been applied to the image to enhance the gray level near the edge. Second, thresholding has been applied to the equalized image in order to obtain a binarized image with gray level 1 representing the tumor and gray level 0 representing the background.
The features extracted are used in the Knowledge Base which helps in successful classification of unknown Images. Image preprocessing consists mainly of two steps. Image segmentation means to isolate the brain tumor from the given MRI sample and image enhancement to increase

the contrast between the whole brain and the tumor. Contrast is present between brain and tumor but beyond the human perception. Hence there is need to increase the contrast between brain and tumor.

IV. IMAGE CLASSIFICATION STAGES

All the slices processed by the system have been automatically classified as abnormal. They are known to contain Astrocytoma tumor based on radiologist pathology report. The brain image which is to be tested for tumor is given in figure 2

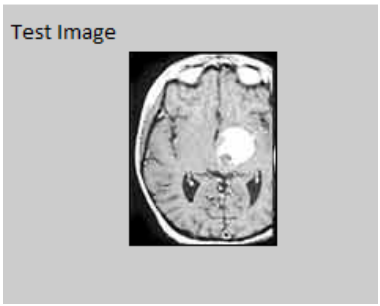

Fig.2. Image to be tested.

Segmentation:

Segmentation subdivides an image into its constituent parts or objects. The level to which this subdivision is carried depends on the problem being solved, that is, the segmentation should stop when the edge of the tumor is able to be detected, and the main interest is to isolate the tumor from its background

Histogram Equalization :

The given MRI is equalized using histogram. The Histogram of an image represents the relative frequency of occurrences of pixel in a given image. The non-uniform varying image due to external conditions is equalized to a uniform variation.Figure 2 shows the image equalized using histogram.

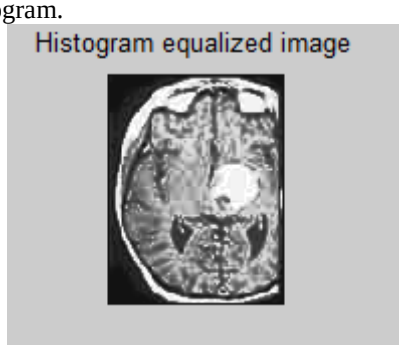

Fig.3. Image equalized using histogram

Binarization:

For the equalized image the pixels are represented in a 0 to 255 gray level intensity. As the process is to extract the affected region or the accumulated region, a 2-level image representation would be sufficient for better computation.

Fig.4. Image binerization

Thresholding:

Thresholding has been used for segmentation as it is most suitable for the present application in order to obtain a binarized image with gray level 1 representing the tumor and gray level 0 representing the background. In simple implementations, the segmentation is determined by a single parameter known as the Intensity Threshold. In a single pass, each pixel in the image is compared with this threshold. If the pixel's intensity is higher than the Threshold, the pixel is set to white, in the output. If it is less than the Threshold, it is set to black.

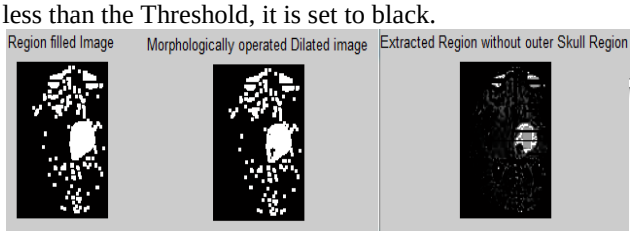

Fig.5. Image thresholding

Morphological Operations:

This is used as a image processing tools for sharpening the regions and filling the gaps for binarized image. The dilation operator is used for filling the broken gaps at the edges and to have continuities at the boundaries. A structuring element of 3x3 square matrix is used to perform dilation operation.

Region Extraction:

Onto the dilated image a filling operator is applied to fill the close contours. To filled image, centroids are calculated to localize the regions as shown beside. The final extracted region is then logically operated for extraction of Massive region in given MRI image.

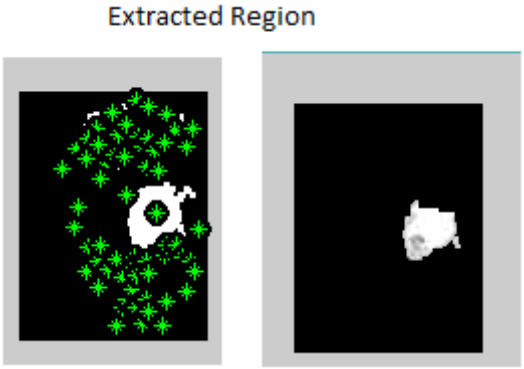

Fig.6. Image region extraction.
The extracted region of image

Feature Extraction:

To the extracted region the feature extraction process is applied for the calculation of 5 invariant features as Area, Homogeneity, Contrast, ASM (Angular second moment), Entropy. The work involves extraction of the important features for image recognition. The features extracted give the property of the texture, and are stored in knowledge base The extracted features are compared with the features of Unknown sample Image for classification. Texture features or more precisely, Gray Level Co- occurrence Matrix (GLCM) features are used to distinguish between normal and abnormal brain tumors. Five co-occurrence matrices are constructed in four spatial orientations horizontal, right diagonal, vertical and left diagonal (0, 45, 90, and 135). A fifth matrix is constructed as the mean of the preceding four matrices.

V. CONCLUSION

This paper implements an efficient system for the detection of cancer from a given brain MRI and recognizes the extracted data for further applications. It finds efficient usage under biomedical early cancer detection. The work can be efficiently used in the area of medical science such as Computer aided diagnosis & Mammography, for predicting early brain cancer cells using texture features and neuro classification. etc. Texture features are used in the training of the neuro- model. Co-occurrence matrices at different directions are calculated and Grey Level Co-occurrence Matrix (GLCM) features are extracted from the matrices. . We design cancer recognition system for the classification and estimation of cancer affect on given MRI image and evaluate the performance of classification rate and the efficiency for the implemented automated recognition system.

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