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Brain Tumor Detection and Classification Using Histogram Thresholding and ANN

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***Abstract*— Brain tumor is the extensive antecedent of the bereavement with common people. It is obvious that the probability of endurance can be improved if the tumor is detected and classify properly at its early phase. The segmentation of brain tumors in magnetic resonance images (MRI) is a difficult one since the range of their promising shapes, locations, image intensities. In this paper, it is projected to encapsulate and evaluate the method of mechanical recognition of brain tumor through Magnetic Resonance Image (MRI) with Histogram Thresholding and Artificial Neural Network. The anticipated method can be effectively useful to distinguish the shape of the tumor and its geometrical measurement. Also in this paper, a tailored Artificial Neural Network (ANN) model that is based on learning vector quantization with image and data analysis and exploitation technique is anticipated to carry out a computerized brain tumor classification using MRI-scans. The appraisal of the adapted ANN classifier concert is deliberate in terms of the guidance performance, classification accuracies and computational time. MRI (Magnetic resonance Imaging) brain tumor metaphors detection is a difficult mission due to the inconsistency and Convolution of tumors. This paper present two techniques for the exposure purpose; first one is Histogram Thresholding and another one is Artificial Neural Network technique. The planned Neural Network technique consists of some stages, specifically, feature extraction, dimensionality diminution, recognition, segmentation and organization. In this paper, the purposed scheme is additional precise and effectual for the brain tumor detection and segmentation.**

***Keywords*— Artificial Neural Network (ANN), Edge detection, image segmentation, brain tumor detection and Histogram Thresholding**

I. INTRODUCTION

Brain have an extremely composite construction and is measured as a most important part as of the body. Environment have securely protected the brain surrounded by a cranium that hinder the cram of its purpose as well as make the verdict of its disease supplementary intricate. But, brain is not flat to disease and can be exaggerated by the unusual expansion of the cells in that transform its ordinary configuration and performance; a syndrome normally identified as a brain tumor. Brain tumors also comprise tumors in the innermost spinal canal or contained by the cranium. Habitual defects detection in MRI is relatively constructive in numerous diagnostic and healing applications computed tomography and MRI are two imaging modalities that facilitate researchers and medical practitioners to learn the brain by look at it non-invasively. Majority of the time, the tumor segmentation and classification become harder due to quantity of MR images and blurred boundaries. Since brain is secured by the cranium, consequently, an early recognition of brain tumor is only probable when analytical tools are aimed at intracranial cavity.

II. PROPOSED METHOD

This part illustrates the on the whole procedure of projected Brain Tumor Detection and Segmentation Using Histogram Thresholding and Artificial Neural Network Technique . In this Paper, the planned scheme is a modified side of the Artificial Neural Network. The modification is based on regular consumption of particular regions of interest (ROIs) inside the tumor corner in the MRI images using Histogram Thresholding technique. Shape each ROI, put of extracted texture contain tumor outline and strength individuality are extracted and normalize. Each ROI is then specified a load to approximate the PDF of every brain tumor in the MR image. These weights are worn as a model procedure to change the Artificial Neural Network. The accessible work is based ahead Histogram Thresholding and Artificial Neural Network for brain image segmentation and brain tumor recognition.

Proposed method consist of different stages:

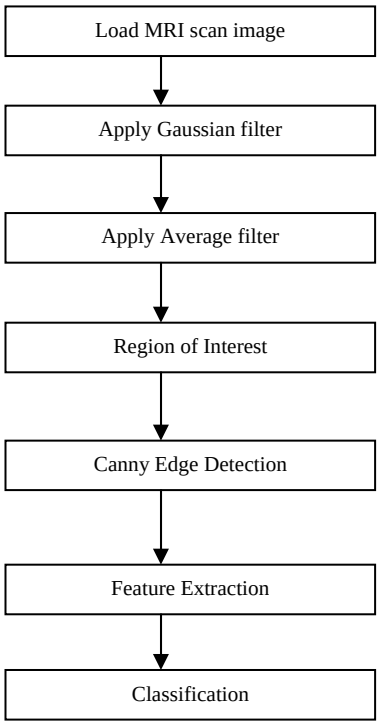
A. Smoothing using Gaussian filter and Average filter

There are many types of noise encountered by many techniques, based on the noise nature and characteristics, that are Gaussian noise and impulse noise. In this paper the main image noise is additive and random. The projected Gaussian smoothing filter is a nonnegative, real valued column matrix. The thought of average filtering is just swap the each pixel value in an image with the mean ('average') value of its neighbours, together with itself. This have the result of eliminating pixel values which are unreliable of their ambiance.

B. Region of Interest

The purpose of segmentation is to identify and modify the illustration of an image into something that is extra significant and easier to evaluate.ROI is a preferred division of sample within a data set recognized for a meticulous function. In projected work adaptation is based on regular

utilization of particular region of interest within the tumor area in the MRI images using Histogram Thresholding method. Histogram Thresholding based image segmentation is the procedure of dividing a digital image into numerous segments.



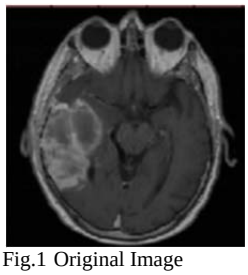


Fig.1 Original Image

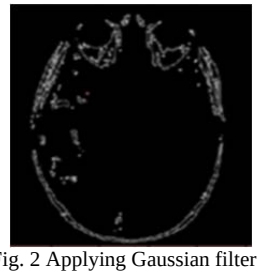


Fig. 2 Applying Gaussian filter


Fig. 3 Applying Average filter

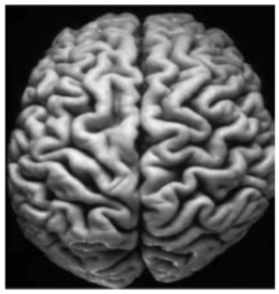


Fig. 4 symmetrical structure of the brain

1) Preprocessing: The image of the brain obtained during MRI is encumbered .The image is then transformed to gray color image, i.e., 2D image. The gray color image contain of pixel intensity between 0-255 where 0 represents black and 255 is for white.

*2) Division the image :*After converting the image into gray color image, it is divided into two equal halves along its central axis. The following algorithm is applied to achieve this:[2]

- The image pixels are stored as a variable (say P) where P shows the values of the pixels in a 2D matrix (row column) form.
- The image pixels are stored as a variable (say P) where P shows the values of the pixels in a 2D matrix (row column) form.
- Number of rows and columns are assigned some other variables (say Q and R).
- The column value is divided by 2 and assigned another variable name (say S).
- Form new matrix using for loop by rows from 0:1:Q as outer loop and columns from 0:1:S as inner loop. This image will be the halves of the original image.
- For the other half of the image, the column value from S:1:R is considered as the inner loop.

3) *Plot the histogram and compare them*: Histogram is a conspire between number of pixel and pixel intensity. Bar graph can be used to plot the histogram. The histogram code operates by first reading the grayscale value at the first entry and upcoming with pixel intensity between 0 and 255. It increases the whole number of pixels and then it will travel to the next row or column entry awaiting it finishes analyzing all the raster data. However, while it is reading each entry, if it picks up pixel intensity value more than once it will augment that particular value. Finally the two histograms are compared to recognize the tumor and thus the tumor.

4) Choose threshold point: The variation of the two histograms is calculated and the consequential difference is plotted suing bar graph to select the threshold point.

5) *Segmentation using threshold point:* Segmentation subdivides an image into subparts. This procedure is incessant until the boundary of the tumor gets detected. The threshold value is compare with the all pixel of MRI image. If the threshold value is greater than pixel value of an image then take away that pixel from an image. If the threshold value is lower than pixel value of an image then that will stay as it is (ie not take away from the image). We are removing pixel by pixel in the MRI image with the threshold value. After thresholding we obtain binary image Since the MRI image has only 2 values binary 0, binary 1(255). The pixel value of an image greater than threshold value those pixel values put to binary value 1 (255) enduring set as binary 0. The output is tumor with dark background.

6) *Image Cropping:* Cropping is the procedure of selecting preferred region from an image that is to be processed. The image shows the preferred tumor portion. This cropped image is used to calculate the tumor area.

7) Area Calculation: Area of an image is the total number of the pixels there in the region which can be

calculated in the length units by multiplying the number of pixels with the dimension of one pixel. From the horizontal and vertical resolution one can obtain the dimension of a single pixel. The algorithm used is follows:[2]

- There are 96 pixels in one inch. Hence vertical dimension of a pixel is 1/96 inch.
- Similarly horizontal dimension of a single pixel is 1/96 inch
- Area of single pixel is equal to (1/96)*(1/96) square inch.

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A = (1/96)*(1/96)
Area of the tumor = A*total

C. Canny Edge Detection

There are 5 steps in algorithm:

1) Smoothing: Consequently the image is first smoothed by applying a Gaussian filter. That we discussed above.

2) Finding gradients: The edges be supposed to be marked where the gradient of the image has huge magnitudes. In this step we work out incline direction and amplitude of smoothed image I_A (x,y) adopt first order fractional predetermined distinction of 2×2 neighborhood.[4]

$$M(x,y = \sqrt{g^2x^{(x,y)} \times g^2y^{(x,y)}}$$

$$\theta = \arctan(g_y(x,y)/g_x(x,y))$$

$$f(x) = \begin{bmatrix} -\frac{1}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{1}{2} \end{bmatrix} \quad f(y) = \begin{bmatrix} \frac{1}{2} & \frac{1}{2} \end{bmatrix}$$

where g_x and g_y are the gradients in the x- and y-directions respectively and represents the results of the original image filtered along rows and lines. θ is the gradient direction.

2) 3) Non-maximum suppression: Only local maxima must be apparent as edges. If the gradient amplitude of the pixel is no fewer than the gradient amplitude between two contiguous pixels in the gradient route, the point can be judged as the edge point probably . The principle of this step is to change the indistinct edges in the image of the gradient magnitudes to jagged edges. Essentially this is done by preserving all local maxima in the gradient image, and eliminating everything else.

4) Double thresholding: Potential edges are resolute by thresholding. Edge pixels stronger than the high threshold are marked as strong; edge pixels weaker than the low threshold are concealed and edge pixels between the two thresholds are marked as weak.

5) Edge tracking by hysteresis: Final edges are dogged by repressing all edges that are not connected to a very convinced (strong) edge. Strong edges are interpreted as convinced edges, and can instantly be integrated in the final edge image. Weak edges are incorporated if and only if they are connected to strong edges.

Fig. 5 Canny Edge Detection

D) Classification of Brain tumor using ANN

An appropriate artifcial neural network classifier is designed in this paper to categorize the distinctive grades of brain tumors. Artificial neural networks are composed of simple elements operated in parallel. These elements are encouraged from biological nervous system. Each element in a network called neuron. The sum of multiplication of weights and inputs plus prejudice at the node is positive then only output elements fires. Fire means it discharges energy to next element. Otherwise it doesn't fire.

1) Probablilistic Neural Network: Probabilistic neural networks (PNN) are a type of radial basis network appropriate for classification problems. A PNN is mainly a classifier because it can map any input pattern to a number of classifications that is Probabilistic neural networks can be used for classification problems.

The proposed system has two stages:

Stage 1: The first stage in the system offered here is training and learning. In Learning/Training.Phase the ANN is trained for gratitude of distinct Astrocytoma types of brain cancer.The known MRI images are first processed through different image processing steps such as Histogram Equalization, Thresholding, and morphological operation etc. and then textural features are extracted using Gray Level Co-occurrence Matrix. The features extracted are used in the Knowledge Base which helps in unbeaten classification of unknown Images. In Probabilistic Neural Network these features are directly provide as an input to PNN based classifier. The features such as angular second moment (ASM) or energy, contrast, inverse difference moment (IDM) or homogeneity, dissimilarity, entropy, maxi-mum probability and inverse for each type of MRI

image that was trained for the neural network is shown in table.

Stage 2: To test unknown MRI image sample and classify, two steps are performed. Test the above features with the desired values of neural networks to establish the MRI image belong to which grade of brain cancer.[4]

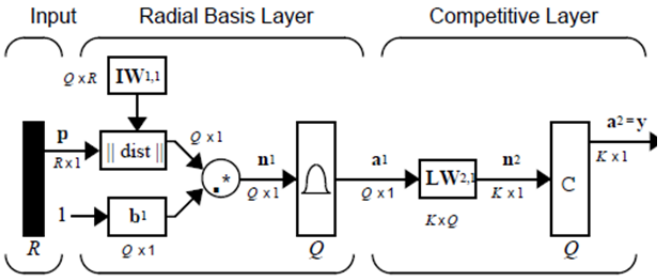

Fig. 6 PNN Architecture

- Input Layer: The input vector, denoted as **p**
- Radial Basis Layer: the vector distances between input vector p and the weight vector Here, the vector distance is defined as the product between two vectors

  radbas(n)= e^{-n^2}
- The output of the network is a linear combination of radial basis functions of the inputs and neuron parameters.

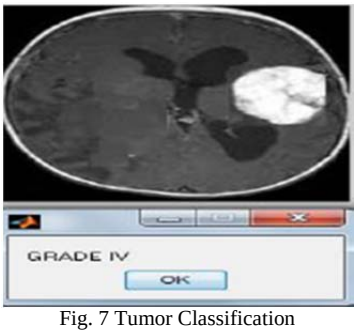

Fig. 7 Tumor Classification

III. Conclusions

In this paper, we proposed two approaches for Brain tumor detection, identification and classification. The first approach is based on an incorporated set of image dispensation algorithms, whereas the other is based on a customized and enhanced probabilistic artificial neural networks structure.

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