Decision Support System for Detection of Brain Tumor on T2-Weighted MRI Images

Engineering

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ABSTRACT

The objective of the paper is to introduce the method for the detection of tumors in human brain on the basis of T2-weighted MRI images. The author developed method which detect tumor area in human brain on the basis of bitmapped digital MRI Images. The detection has been done on the basis of multiple parameters i.e. edge, gray & contrast values which is compared with standardized parameters for detecting the abnormal occurrences i.e. tumor or lesions cells. Using different brain disease MRI dataset the experiments were performed. The experiment results shows that the conceptually simple proposed method is effectively detect tumor blocks.

Introduction

As per the survey conducted in the United States this year 12,820 men and 10,560 women (23,380 adults) will be diagnosed with primary cancerous tumors of the brain & spinal cord. Estimations give the statistics that 8,090 men & 6,230 women (14,320 adults) will be die from this disease this year.

In recent years the development in medical science & imaging techniques given facility to use these techniques in various domains of medicine like surgical planning, time series and statistical analysis, computer aided pathologies, surgical guidance diagnosis. The magnetic resonance imaging is the technique used by creating strong magnetic field by passing an electric current through wire loops. At the same time other coils in the magnet send & receive radio waves. The protons are triggered in the body to align themselves. The radio waves are observed by the protons once it aligned which simulate spinning. After exciting molecules energy is released, this in turn emits energy signals that picked up by the coil. Finally this information is then sending to a computer for generating image after processing all the signals. This process not involves ionizing radiations unlike CT scanning or general x-ray studies. Figure 1 shows some of the datasets of MRI images of brain with tumor & non-tumor.

LITERATURE SURVEY

By considering different approaches we studied, M.Karnan [7] demonstrate the method of tumor detection using segmentation by soft computing. J.Li,S.Ghanavati et al [9] introduced the brain tumor detection technique by extracting the features like deformation, intensity, symmetry & texture features. M.Monica Subashini et al [10] represents the model Pulse coupled neural network by giving segmented MRI as input which detects the presence of tumor in the brain image. Shraiya Nancy et al [11] et al represents the technique with three steps that is preprocessing, histogram equalization & segmentation S.Chandra et al [5] represent a clustering based algorithm on Particle Swarm Optimization (PSO). A.Azamimi Abdullah, T.Logeswari et al [12] represent the detection method based on cellular neural networks (CNNs).A.Islam et al [13] proposed a stochastic model by using Magnetic Resonance Imaging for characterizing tumor texture in brain.

Pavel Dvorak et al [15] proposed the technique that determines whether the input MRI image of brain contains a tumor or not by checking the symmetry of the brain which is assumption for healthy brain. T.Rajesh, R. Suja Mani Malar [14] represents the paper that shows that MRI image given as input & features are extracted from that image based on Rough Set Theory. Eyup Emre Ulku et al [16] represents the brain tumor detection using Computer-aided detection system. The brain tumor detection technique using K-means clustering is introduced by J.Vijay, J.Subhashini [17]. Ishita Maiti et al [18] introduced a new method for brain tumor detection using watershed method which is

color based brain tumor detection algorithm which uses color MRI images of brain in HSV color space.
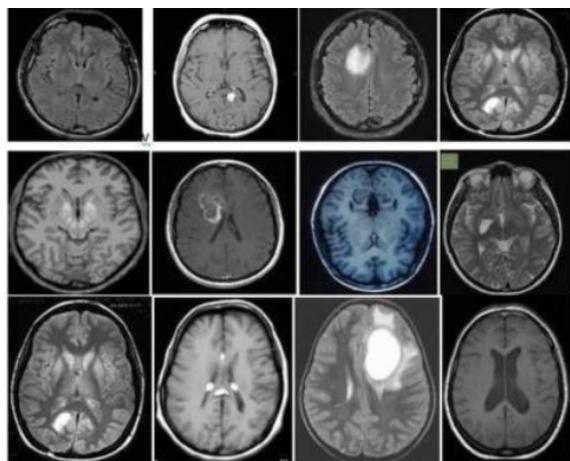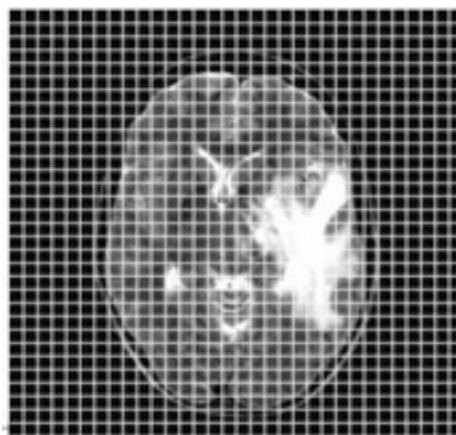

Fig 1: MRI brain Image dataset

Fig 2: Supervised Block – Image with 256 x 256 pixels with block size B (8x8 pixel)
Total 1024 Blocks for processing.

METHODOLOGY

A. Methodology (Theoretical)

In proposed work we are introducing simple supervised block based image processing method to analyze Magnetic Resonance brain images with relatively less computational requirement to detect tumor danger blocks. The scope of this work is to detect

the suspected block of containing malignant lesions in MRI images. These regions require more thorough examination & observation by medical experts for a second clinical evaluation of disease.
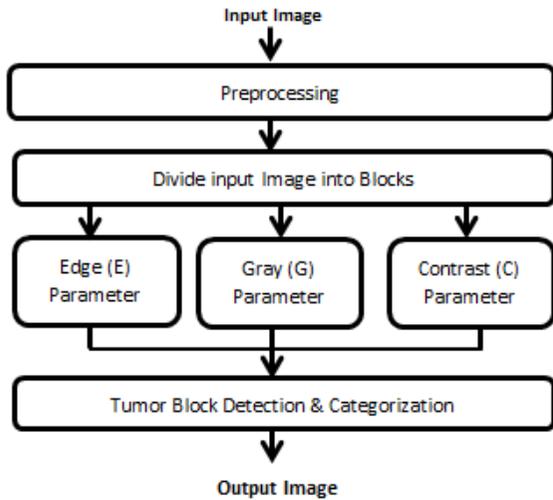

Fig 3: System Architecture

The proposed system we divided into two sections i.e. 1.Supervised feature Block Section & 2. Parameters Calculation Section.

Supervised feature Block
In most of the medical images such as MRI, the structure of interest such as lesions & tumors, occupy area well below ten percent of the total number of pixel. Conventional medical images have very minor changes time to time as per changes obtained in human body. It is not possible to detect minor differences in the image by processing whole area of interest at a time.

To analyze such changes in the small tissues we defined a block system which divides the area of interest into block size. A block is the part of the whole image which is obtained by divide evenly with the factor of eight. The input to the DSS is T2-wieghted MRI image with 256 x 256 pixel. We divide this image into block size 8x8 pixels. Therefor total 1024 blocks are processed for each image.

Parameter Calculation
The different ways are used for analyzing medical images into functionally and medically meaningful regions in the recent development of the of the medical image analysis. We calculated following three parameters:

Edge Parameter (E)
To determine boundaries of an object the edge information is used. The edge information is mainly used to analyze the similarity criterion for the predetermined object. The Sobel edge detection method is used to detect image edges i.e. I_E.

$$H_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}, \quad H_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} \quad (1)$$

$$I_E(x, y) = \sqrt{I_1^2(x, y) + I_2^2(x, y)} \quad (2)$$

$$E(r, c) = \sum_{(x,y) \in B}(I_{EP}==1) \quad (3)$$

where ,
Hx = Vertical Contarst,
Hy = Horizontal Contrast
I1 and I2 are the Images got by filtering the input image with the two convolution kernels concurrently to detect changes in Hx & Hy

IE = Image output obtained by calculating Gradient Magnitude

E(r, c) = Edge Parameter i.e. increase by one every time when IE (x, y) = 1 in the supervised block

Gray Parameter (G)
The value of gray parameter is calculated using the equation 6 as shown below.

$$IaV_S = \frac{1}{65536} \sum I_P(x, y) \quad (4)$$

$$G_D = \frac{\sum_{S=0}^{T} IaV_S}{T} \quad (5)$$

$$G(r, c) = \sum_{(x,y) \in B}(I_P(x, y) \text{ For all } (I_T(x, y)==1) \quad (6)$$

Where,
T = Total image slices
I_P = Gradient Magnitude of respective pixel
$I_T(x,y)$ = Binary Image value
IaV_S = Average pixel value of respective image slice (s)
G_D = Threshold value
G(r,c) = Gray parameter

Contrast Parameter (H)
The Contrast parameter is getting by the following equations by using min-max stretching formula as shown below.

$$I_H(x, y) = \left(\frac{I(x,y) - minH}{maxH - minH}\right) \times maxH \mid H \in C_8(I_H) \quad (7)$$

$$H_d(r, c) = \sum_{(x,y) \in B} I_H(x, y) \quad (8)$$

Here, minH and maxH showing the minimum intensity values and maximum intensity values of the neighborhood pixel $C_8(I_H)$ in supervised block.

IH is contrast of supervised block.
B. Methodology (Mathematical/Logical Model)
Input parameter

I= {I1}
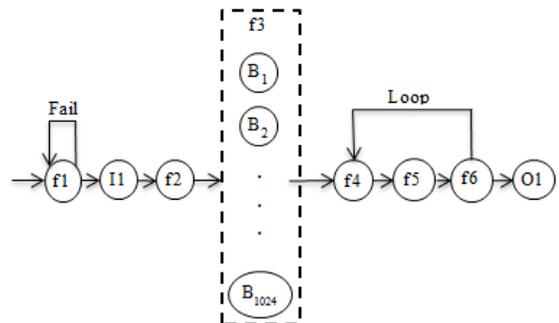Where, I is a set of Input.
I1= T2-Wieghted MRI Image

Fig 4: Mathematical Model of the proposed system

Function parameter
F = { f1,f2,f3,f4,f5,f6}
Where, F is a function for processing.

f1= Authentication.
f2= Preprocessing

f3= Block Separation {B_1 B_2,.........,B_{1024}}
f4= Applying EGH parameter on each block
f5= Danger Block Detection
f6= Categorization

Output parameter
O = {O1}
Where, O is the Output.
O1=Output Processed Image

CONCLUSION
The proposed technique effectively capable to identify the tumor areas in the given T2-weighted brain image as input taken from the MRI dataset consisting of different cases. The technique is capable to help the doctors to analyze the tumor area in human brain.

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