The Prophecision and Categorization of Brain Tumour using Artificial Neural Network

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Abstract **- The method of human analysis on medical images is the difficult task. This is mainly due to very minute variations and the co-resemblance between affected & original biological part and it also requires a larger data set for analysis. This makes the biological analysis for prediction a tedious one. This problem grows complicated under the prediction of cancer basically in brain. The challenging task is to develop an automated recognition system which could process on a large information of patient and provide a correct estimation of the results. This project deals with an automated cancer recognition system for MRI images. We implement the neural network algorithm on the given MRI image for the classification and estimation of affected regions.**

Keywords - Co-resemblance, MRI images, Neural Network, Biological analysis, Backpropogation.

I. INTRODUCTION

An Artificial Neural Network (ANN) is the computational model inspired by its functions and the aspects of the biological analysis. This is also called as the Simulated Neural Network (SNN) or commonly just neural network (NN). This commonly consists of inter-connected group of artificial neurons. This is used as a mathematical or computational model for processing the information based on a connectionist approach to computation models. A technique in which the data from an image are digitized and various mathematical operations are applied ANNs are being defined by 3 parameters namely

- Interconnection Patterns.
- Weights of the Interconnections.
- Activation Functions.

Mostly ANNs are the Adaptive system, but the modern uses the non-statistical data modeling tools. These are being organized by different architectural modeling tools. Applications include the system identification, game playing, decision making, medical recognition and data mining.

Image processing is one of the signal processing for which the input is an image. This involves the image as the two dimensional view. The most active area of research in such diverse fields as medicine, astronomy, microscopy, seismology, defense, industrial quality control, and the publication and entertainment industries is the Image processing. One of the biggest advantages is that the ability of the operator to post process the image. This also allows the electronic transmission of the signals.

II. BRAIN TUMOUR

Brain tumours are usually defined as the group of similar cells that do no follow normal cell division and growth patterns. This can be both cancerous and non-cancerous (benign). Tumours are found by CT or MRI brain scans. In general the benign tumours do not reoccur after the removal. Some of the causes are Radiation Exposure or the Exposure to the Chemicals. The symptoms of the brain tumour can vary based on the onset of the disease. Some of the symptoms include weakness, difficulty in walking, seizures, blurry vision.

Primary and secondary brain tumours are the types of the brain tumours. Primary brain tumours arise from the brain or the spinal cord. Primary tumours can be Malignant and they rarely spread beyond the central nervous system. This is increased partly due to the fact that people now have higher life expectancy and we are much more skilled. The causes are the Environmental

Exposures and the role of Genetic development. The symptoms vary based on the location of the tumour and the size.

Secondary brain tumours are often called Metastatic tumours, are the result of cancer cells originating from another part of the body that have spread to the brain. These tumours are more common than the primary tumours. In rare case is that Metastatic brain tumour is discovered before the originating cancer site is being detected.

Both the tumours are life threatening and are usually very aggressive. The early detection of a brain tumour only occurs when diagnostic tools are directed at the intracranial cavity. Usually detection occurs in advanced stages when the presence of the tumour has caused unexplained symptoms. Many diagnostic tools are being discovered for the detection of these tumours.

III. MRI IMAGE

Magnetic resonance imaging (MRI), nuclear magnetic resonance imaging (NMRI), or magnetic resonance tomography (MRT) is a medical imaging technique used in radiology to visualize detailed internal structures. MRI makes use of the property of nuclear magnetic resonance (NMR) to image nuclei of atoms inside the body.

MRI provides good contrast between the different soft tissues of the body, which makes it especially useful in imaging the brain, muscles, the heart, and cancers compared with other medical imaging techniques such as computed tomography (CT) or X-rays.

IV. PROPOSED SYSTEM

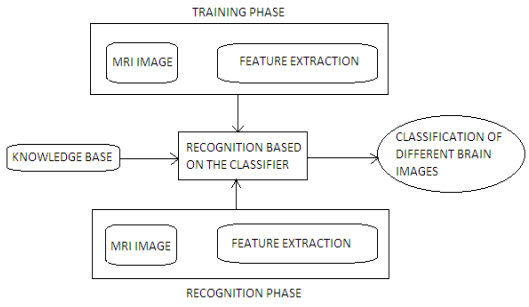

Fig.1 Block diagram of proposed method.

V. EVALUATION MODELS

The given query sample are evaluated by using the following models. This is used both for database images and the query images.

A. Histogram equalization

Histogram is the Graphical representation showing the visual impression of the distributed data. This is one of the methods in image processing. This is the contrast adjustments using the images. Histogram equalization accomplishes the effective spreading of the most frequent intensity values. This method is useful for either the images with foreground and background which are being both bright or both dark. This produces the unrealistic effects and also the undesirable effects like image gradient. Applied to the images like thermal, satellites or the X-ray images.

This is also used in the Biological neural network to maximize the output firing rate of the neuron as the function of input. This method seeks to adjust the images to make it easier to analyze or improve visual quality

The important operations are based upon the manipulation of an Image histogram or a Region histogram. The most important Histogram based operations are given below

- Contrast Stretching.
- Equalization.

The histogram equalization has three steps when it is being applied on an image

- Histogram Formation.
- New Intensity Values calculation for each Intensity Levels.
- Replace the previous Intensity values with the new intensity values.

B. Binarization

Binary image is the digital image that has two possible values for each pixel used namely Black and White. Binarization is the process of converting the image of 256 pixels to the image of black and white. Some of the operations performed are Segmentation, Thresholding and Dithering. The simplest way to use image Binarization is to choose a threshold value.

Binarization is recognized to be one of the most important steps in high-level image analysis systems. This is being proposed particularly for Medical image data. The following are the steps followed in Binarization

- Extract the affected or the accumulated regions and choose threshold value.
- Next the Thresholding method used for the binarized image.

Binarized image b(i,j)= 255
{
if e (i, j) > T
else b (i, j) = 0
} (i)

Where e (i, j) is the equalized MRI image and T is threshold derived for the equalized image.

- A masking matrix is derived by using a neighbourhood estimation method.

M is the masking matrix derived using neighbourhood estimation method,

Let e = p1 p2 p3
p4 p5 p6
p7 p8 p9

Let e be the equalized image matrix. Then the masking element

M (p5) = max (| p4 – p6 |, |p2 – p8 |) (ii)

C. Morphological Operations

The word morphology commonly denotes a branch of biology that deals with the form and structure of animals and plants. This is usually being for identifying of the object boundaries. This morphological operation used for image filtering, thinning, and fill the gaps of the image. Operations are being applied on the 3x3 pixel neighbours. Pixel of interest lies at the center represented as X and surroundings are represented by X0 to X7. The following are some of the important operations used for the MRI image detection of the tumour

1)Erosion:

Erosion eliminates the unwanted white noise pixels from black area. The pixel in the neighbourhood should be 1.

$$E(A, B) = A\Theta(-B) \cap (A-\beta) \quad \text{(iii)}$$

Uses AND operations for the functions.

2) Dilation:

Dilation makes the white area grow or dilate. This is useful for removing the isolated black pixels from an image.

$$D(A, B) = A\Theta \cup (A+\beta) \quad \text{(iv)}$$

Uses NAND operation for the functions.

D. Region Extraction

The area which is obtained by Region Growing method is considered as a new base image in the next step, and this extraction process is repeated for all slice images. Finally, we extracted the area of tumour and brain, and both are visualized in three-dimensional domain simultaneously to understand the position relations of the tumour. 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.

E. Feature Extraction

This is the special form of the dimensionality reduction. Transforming the input data into the set of features is called as the feature Extraction. This can be applied for the extracted region with 5 invariant features.

- F1 Area

The quality that expresses the extent of the region.

- F2 Homogeneity (Inverse Difference Moment)

This is defined as the state of being similar extent.

$$F2 = \sum_{i,j=0}^{N-1} (Pi,j) / (i - (i*j)2) \quad \text{(v)}$$

- F3 Contrast

Contrast is the difference in luminance that makes an object representation.

$$F3 = \sum_{i,j=0}^{N-1} Pi, j\ (i-j)\ 2 \quad \text{(vi)}$$

- F4 Angular Second Moment (ASM)

This is also called as uniformity. Each p(i,j) is used as a weight for itself.

$$F4 = \sum_{i,j=0}^{N-1} Pi,j \quad \text{(vii)}$$

- F5 Entropy

This is the property that can be used to determine the energy that is not available.

$$F5 = \sum_{i,j=0}^{N-1} Pi,j\ (i-j)\ 2 \quad \text{(viii)}$$

The above functions are being applied on a clustered database consisting of different distinct MRI images. The database is divided into Low grade and the High grade classes.

F. Low Grade Classes

These are slow growing with relatively well defined borders. These are assigned to I and II.

1) Class I – Gliomas:

Composes the supportive tissue of the brain.

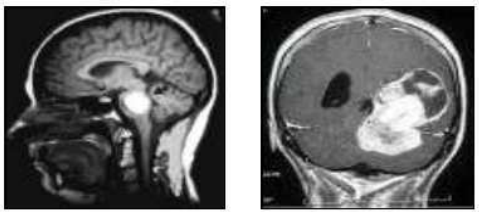

Fig.2 Gliomas Class

2) Class II – Astrocytoma:

Abnormal growth of tissue which usually spread outside the brain and the spinal cord.

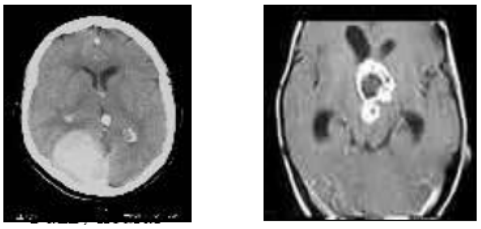

Fig.3 Astrocytoma

G.High Grade Classes

Grows much quickly and are being assigned to III and IV.

1) Class III – Anaplastic Astrocytoma:

Most high grade and occurs sporadically and invades the neighbouring tissues.

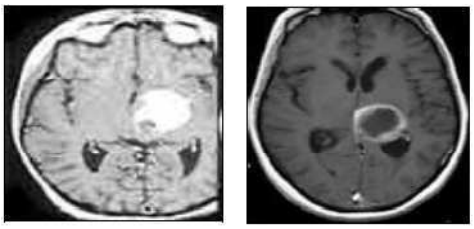

Fig.4 Anaplastic Astrocytoma

2) Class IV – Glioblastoma Multiforme:

Most aggressive malignant brain tumour that has the worst prognosis of CNS.

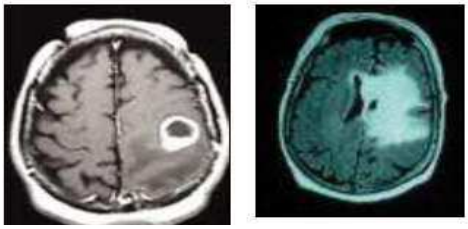

Fig.5 Glioblastoma Multiforme

VI ALGORITHM USED

The algorithm used for the processing is the Back Propagation. One of the feed forward mechanisms such that training patterns are the input through the neural network in order to generate the output propagations. This is a multilayer feed forward network with one layer of Z-hidden units. This usually allows for the quick convergence. Bias acts as a connection from units whose output is always 1. back prorogation occurs actively in the spinal cord while in cerebellum it occurs passively.

Back propagation training takes place in three stages.

- Initialization of the weights.
  Some random values are being assigned for the calculation.
- Feed forward mechanism.
  Each hidden units are calculated for the activation function to form the response of the given output
- Back propagation of the associated error.
  The output is being compared with the target value for the determination of the error.
- Updating of weights and biases.

The weighted and the bias corrections are used for the minimization of the errors.

During feed forward, each input neuron receives an input signal and broadcasts it to each hidden neuron. During training, the net output is compared with the target value and the appropriate error is calculated. The following are some of the merits of these algorithms

- Relatively simple implementation, standard method and relatively works well.
- The mathematical formula used can be applied to any network.
- Computing time is reduced if the weights choosen are small at the beginning.

VII RESULTS

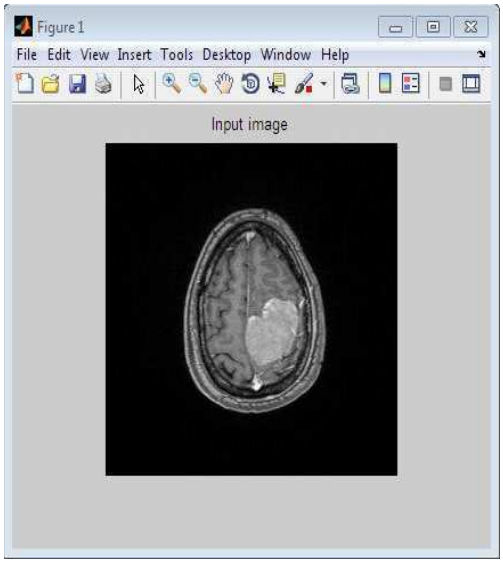

Fig.6 Input MRI image for processing.

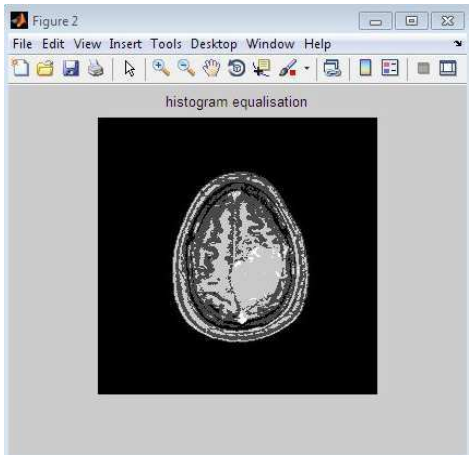

Fig.7 Histogram Equalization

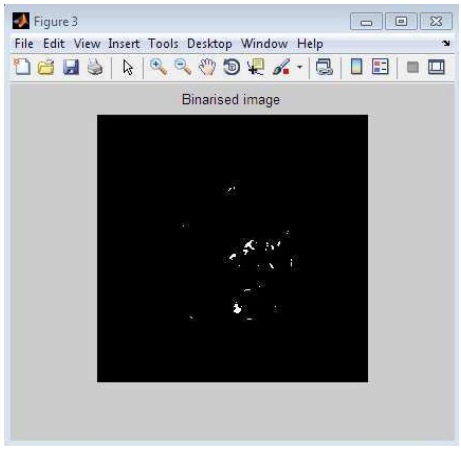

Fig.8 Binarization.

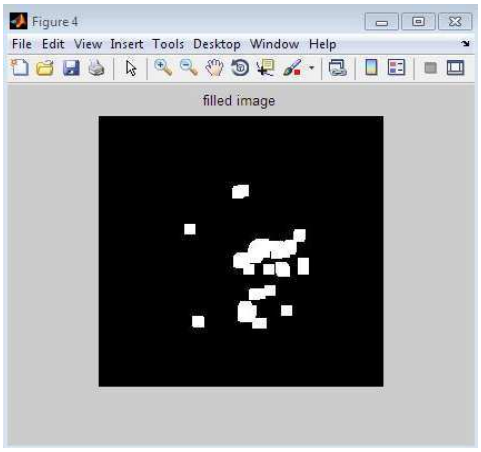

Fig.9 Filled image

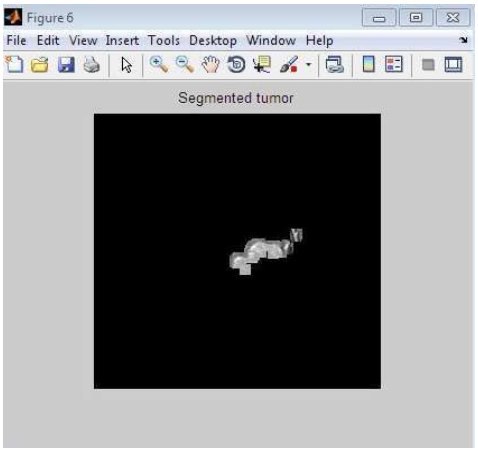

Fig.10 Segmented Tumour

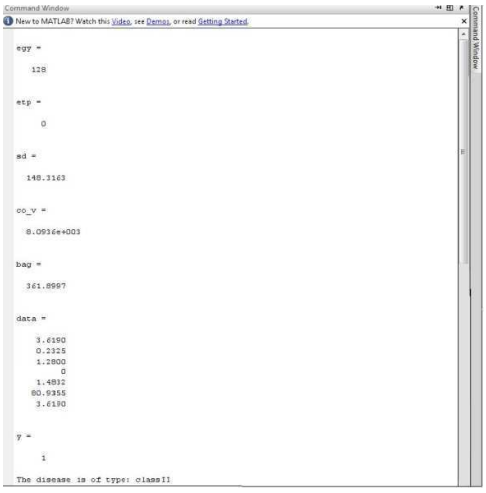

Fig.11 Classified Tumor Classes

VIII. CONCLUSION

This project, the image processing part has been successfully done with the use of MRI image. The features of image processing , Histogram equalization gives the better result for image intensity , Binarization has been classify the black and white operation , morphological operation has been used to contract or expand the image , with the use of feature extraction the area , contrast , angular second moment , entropy were predicted. This image processing part exposed the exact position of the brain tumour. This technique gives the accurate result of the brain tumour. This is used to classify the different type of brain tumours present in human. With the help of Back propagation technique from which neural network has been trained and the brain tumour has been segmented.

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