International Journal of Research in Advent Technology, Vol.2, No.2, February 2014

E-ISSN: 2321-9637

Brain Tumor Detection Using Scan

Jayashree Bhole[1], Prof.A.M.Patil.2
PG. Student EXTC Dept[1,] H.O.D EXTC Dept.[2]
JTMCOET, Faizpur, Jalgaon.[1, 2]
bholejaya1@gmail.com[1]

Abstract— Brain tumor is an abnormal mass of tissue in which some cells grow and multiply uncontrollably, apparently unregulated by the mechanisms that control normal cells. The growth of a tumor takes up space within the skull and interferes with normal brain activity. So detection of the tumor is very important in earlier stages. Various techniques were developed for detection of tumor in brain. This paper focused on survey of well-known brain tumor detection algorithms that have been proposed so far to detect the location of the tumor. The main concentration is on those techniques which use image segmentation to detect brain tumor. These techniques use the MRI Scanned Images to detect the tumor in the brain. Differences between some well-known techniques are also considered in this paper.
Key Terms: - Brain tumor; MRI;

I. INTRODUCTION

In medical imaging, 3D segmentation of images plays a vital role in stages which occur before implementing object recognition. 3D image segmentation helps in automated diagnosis of brain diseases and helps in qualitative and quantitative analysis of images such as measuring accurate size and volume of detected portion.
Accurate measurements in brain diagnosis are quite difficult because of diverse shapes, sizes and appearances of tumors. Tumors can grow abruptly causing defects in neighboring tissues also, which gives an overall abnormal structure for healthy tissues as well. In this paper, we will develop a technique of 3D segmentation of a brain tumor by
using segmentation in conjunction with morphological operations.

A. Tumor:

The word tumor is a synonym for a word neoplasm which is formed by an abnormal growth of cells Tumor is something totally different from cancer.

1) Types of Tumor:

There are three common types of tumor:
1) Benign;
2) Pre-Malignant;
3) Malignant (cancer can only be malignant) [1].

1) *Benign Tumor:* A benign tumor is a tumor is the one that does not expand in an abrupt way; it doesn't affect its neighboring healthy tissues and also does not expand to non-adjacent tissues. Moles are the common example of benign tumors.

2) *Pre-Malignant Tumor:* Premalignant Tumor is a precancerous stage, considered as a disease, if not properly treated it may lead to cancer.

3) *Malignant Tumor:* Malignancy (mal- = "bad" and -ignis = "fire") is the type of tumor, that grows worse with the passage of time and ultimately results in the death of a person. Malignant is basically a medical term that describes a severe progressing disease. Malignant tumor is a term which is typically used for the description of cancer.

Malignant gliomas are the most common primary brain tumorsof humans, accounting for 30% of all primary central nervoussystem (CNS) tumors in adults; they are divided into two types:
(i) anaplastic astrocytoma and (ii) glioblastoma multiforme.Primary malignant brain tumors in the United States areestimated to occur at an incidence of 14.7 per 100,000 people,and 10,000-15,000 new cases are diagnosed annually. Malignant gliomasare ideal candidates for molecular based therapies as: (i) metastases are rare, (ii) imaging studies allow precise monitoring of outcome, and (iii) delivery techniques allow for targeting of therapeutics [30].

B. Magnetic Resonance Imaging (MRI):

MRI is basically used in the biomedical to detect and visualize finer details in the internal structure of the body. This technique is basically used to detect the differences in the tissues which have a far better technique as compared to computed tomography. So this makes this technique a very special one for the brain tumor detection and cancer imaging [2].
CT uses ionizing radiation but MRI uses strong magnetic field to align the nuclear magnetization then radio frequencies changes the alignment of the magnetization which can be detected by the scanner. That signal can be further processed to create the extra information of the body.

Magnetic resonance imaging (MRI), or nuclear magnetic resonance imaging (NMRI), is primarily a

medical imaging technique used in radiology to visualize detailed internal structure and limited function of the body[3]. MRI provides much greater contrast between the different soft tissues of the body than computed tomography (CT) does, making it especially useful in neurological (brain), musculoskeletal, cardiovascular, and ontological (cancer) imaging. Unlike CT, MRI uses no ionizing radiation. Rather, it uses a powerful magnetic field to align the nuclear magnetization of (usually) hydrogen atoms in water in the body. Radio frequency (RF) fields are used to systematically alter the alignment of this magnetization. This causes the hydrogen nuclei to produce a rotating magnetic field detectable by the scanner. This signal can be manipulated by additional magnetic fields to build up enough information to construct an image of the body.

ANALYSIS AND FINDINGS

Now days, one of the main cause for increasing mortality among children and adults is brain tumor. It has been concluded from the research of most of the developed countries that number of people suffering and dying from brain tumors has been increased to 300 per year during past few decades.

Bar Graph is given below, showing number of persons who have diagnosed from tumor and number of persons who died of tumor.

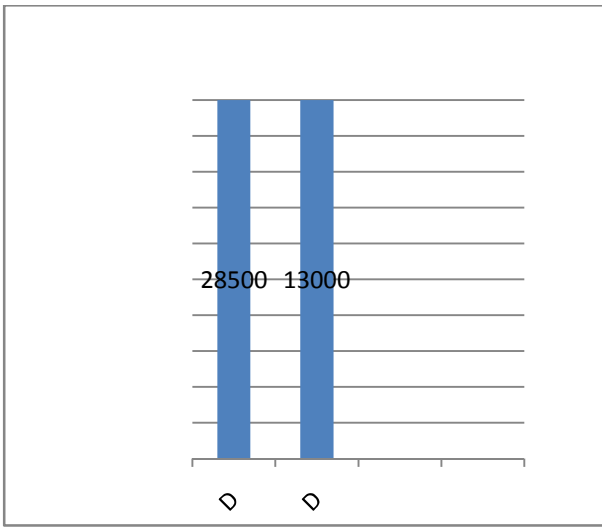


Figure 1: Analysis of Tumor Diagnosis [9]

Pie chart is given below, which shows rate of tumor diagnosis in some countries.

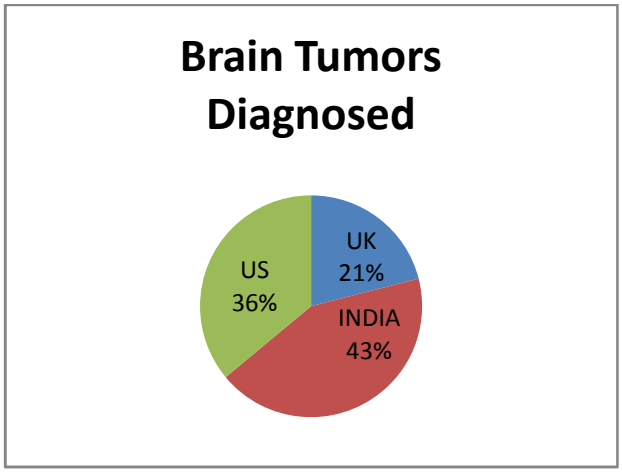


Figure 2: Rate of Tumor Diagnosis Per Year[9]

II. RELATED WORK

REVIEW PAPERS ON BRAIN CLASSIFICATION TECHNIQUES

The growth autonomy of human tumor cells is considered due to the endogenous production of growth factors. Transcriptional expression of candidates for autocrine stimulatory factors such as basic fibroblast growth factor (FGF), acidic FGF, and transforming growth factor type (3 were determined in human brain tumors. It is essential to examine tumor tissue specimens for the presence of mRNAs that encode growth factors, since the presence of RNAs indicates the production by tumor itself rather than the passive absorption or the binding of growth factor peptides synthesized elsewhere. Basic FGF has been widely purified from neuroectodermand mesoderm-derived cells and is known to act as a potent mitogen for these cells, which bear specific FGF cell-surface receptors[29].

At the present early stage it is impossible to compare the quality of the reconstructions with that obtainable by the scanners. In the case of the brain tumor patient, the existence and location of the tumor was confirmed by angiography [28].

The important process in the automated system is brain image classification [24]. The main objective of this step is to differentiate the different abnormal brain images based on the optimal feature set. Several conventional classifiers are available for categorization but most of the earlier works depend on Artificial Intelligence (AI) techniques which yield

highly accurate results than the conventional classifiers. The usage of Artificial Neural Networks (ANN) to improve the accuracy of the classifiers is illustrated by [11].

This report was based on head and neck carcinoma detection and a comparative analysis was performed with the Linear Discriminant Classifier (LDA) to show the superior nature of neural networks. An interactive tool to classify the healthy and the tumorous MR brain images is proposed by [12]. But the accuracy proposed in this system is very low compared to the AI techniques. Though this approach claimed a faster convergence rate, it may not be much useful because of its low accuracy. This report mainly concentrated on improving the convergence rate only. The application of various ANN for image classification is analyzed by [13]. The lack of faster convergence rate of the conventional neural networks is also explained in the report. This lay an emphasis on the requirement of modified neural networks with superior convergence rate for image classification applications. The four different types of tumor is classified using LDA technique by [14]. But the classification accuracy reported in the paper is in the order of 80% which is relatively low. This work also suggested the various reasons for misclassifications. Support Vector Machine based classification of various levels of MR glioma images is performed by [15]. This method claimed to be better than rule based systems but the accuracy reported in the paper is low. This work dealt with only glioma images and thus the lack of generalizing capability of this work is another drawback of this sytem. The application of Kohonen neural networks for image classification is explored by [16]. Some modifications of the conventional Kohonen neural network are also implemented in this work which proved to be much superior to the conventional neural networks. A hybrid approach such as combination of wavelets and Support Vector Machine (SVM) for classifying the abnormal and the normal images is used by [17]. This report revealed that the hybrid SVM is better than the Kohonen neural networks in terms of performance measures. But the major drawback of this system is the small size of the dataset used for implementation. The classification accuracy results may reduce when the size of the dataset is increased. A modification of conventional SVM such as Least Square SVM (LS-SVM) for brain tumor recognition is proposed by [18]. Both bi-level classification and multiclass classification are performed in this work to show the superior nature of the proposed method over the conventional classifiers. This report also specified an important note that the differences between various algorithms increase when the number of classes increase. Thus, this work suggested the necessity for multiclass classification techniques than bi-level classification techniques. Another version of LS-SVM is proposed and successfully implemented by [19]. An extensive comparative analysis is performed between the SVM, neural classifier and the statistical classifiers. Results suggested the advantages of SVM in terms of classification accuracy. Only bi-level classification is performed in this work which is inadequate for judging the nature of the automated system. The modified Probabilistic Neural Network for tumor image classification is used by [20]. A Neuro-Fuzzy Classifier is used to detect candidate circumscribed tumor. ANN'S are networks of interconnected computational units, usually called nodes. The input of a specific node is the weighted sum of the output of all the nodes to which it is connected. The output value of a node is, in general, a non-linear function (referred to as the activation function) of its input value. The multiplicative weighing factor between the input of node j and the output of node i is called the weight wji. An Artificial Neural Network is an adaptive, most often nonlinear system that learns to perform a function (an input/output map) from data. Adaptive means that the system parameters are changed during operation, normally called the Learning/Training phase. After the training phase the Artificial Neural Network parameters are fixed and the system is deployed to solve the problem at hand (The Recognition/Testing phase). Back-propagation .ANN's used in this study consist of one input layer, one or two hidden layers, and one output layer. With back-propagation, the input data (Extracted Features) is repeatedly presented to the Artificial Neural Network, with each presentation the output of the neural network is compared to the desired output (Grade of Tumor) and an error is computed. This error is then fed back (back-propagated) to the Artificial Neural Network and used to adjust the weights such that the error decreases with each iteration and the neural model gets closer and closer to producing the desired output[31].

Abnormal images such as metastase, glioma and meningioma are differentiated using the least square feature transformation based PNN. A comparative analysis is also performed with SVM. This work inferred that the transform based PNN is superior to the SVM in terms of classification accuracy. The different grades of abnormal images are categorized using artificial neural networks by [21]. Emphasis was given for convergence time than the classification

accuracy. The results concluded that the PNN is superior over conventional neural networks in terms of training time period. A computer aided system for discriminating the primary and secondary tumors is developed by [22]. Probabilistic Neural classifier is used in this work.

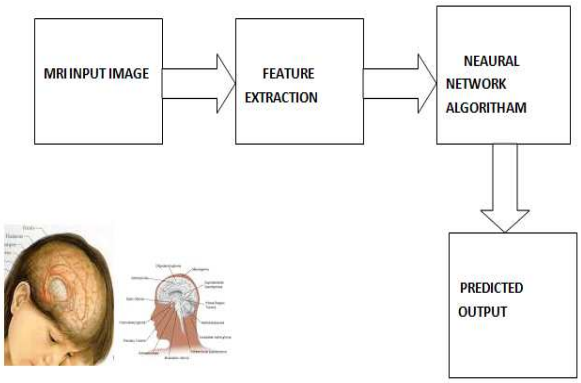
W. Cuatico shown that neoplastic cells of human breast cancers, leukemias, lymphomas,and sarcomas contain particles similar to the viruses that have been established as etiologic agents of these diseases in mice. The present paper concerns tumors of the central nervous system for which no suitable animal model or corresponding virus exists. Nevertheless, using the simultaneous detection test, we showed that human brain tumors contain 70S RNA and RNA-directed DNA polymerase encapsulated in a particulate component possessing a density of 1.17 g/ml. These particles satisfy the three diagnostic criteria that characterize RNA tumor viruses of animals. 24 Out of 26 (92%) of the most malignant (glioblastoma and medulloblastoma) brain tumors examined contained these virus-like entities[26].

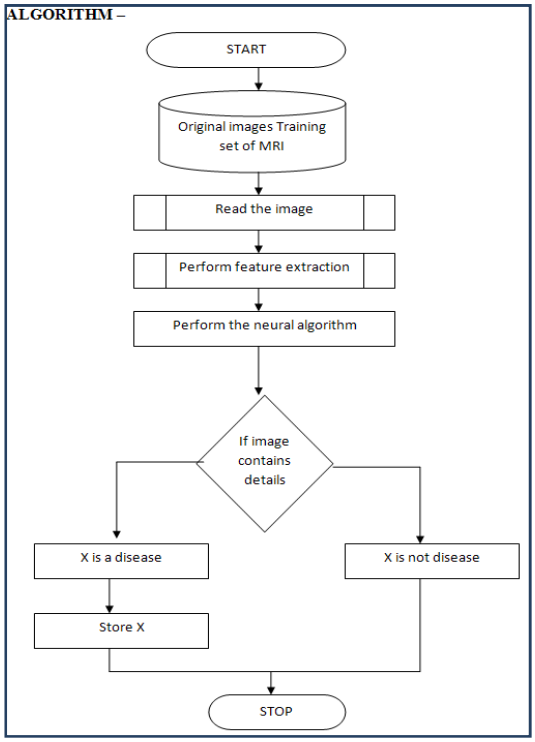
M. Schlumpf, W. J. Shoemakert, And F. E. Bloom Norepinephrine (NE~producing cells of the nucleus locus ceruleus and dopamine (DA) [27] producing cells of the substantia nigra were dissected microscopically from embryonic rat brain, explanted to 5 weeks and describes a modified version of the explants culture technique applied to two regions of rat brain stem that contain neuronal populations utilizing catecholamine as their neurotransmitter.

Segmentation is the process where an image is divided into the different regions on some similarity bases. Basic function of the segmentation is that we can easily extract information and different features from the images. As brain tumor detection is a very time consuming process which is done by medical experts. So to tackle this issue many segmentation techniques are developed by the image processing experts. [3] Many of these techniques are not properly defined rather they are ad hoc techniques.

Some of the most common methods are: *1)* Amplitude thresholding; *2)* Texture segmentation; *3)* Template matching; *4)* Region-growing segmentation [23]
When experts work on tumor images then they use three different types of algorithms. Some of the techniques based on pixel based, some based on texture of images and some of them based on structure of images. Gopal,N.N. Karnan, M. [4] suggested an algorithm which used multi-scale image segmentation, this algorithm was based on fuzzy c-mean algorithm for the detection of brain tumor. Joshi, D.M.; Rana, N.K.; Misra, V.M. [5] suggested an improved technique for tumor detection; this algorithm used neuro fuzzy technique for the segmentation for the tumor detection.
Ming niwu,chia-chen Lin and chin-chenchang[6], proposed an algorithm which uses a clustering technique(k-means) to detect the brain tumor in MR images. First of all they convert the gray scale images into color images and then by the help k means clustering.
Hossam M. Moftah, Aboul Ella Hassanien, and MohamoudShoman [7], they used k mean algorithm with connected component labeling. Clustering can be done with the help of object rendering process in 2D slices and then 3D patch is obtained.
P.Vasuda, S.Satheesh [8], proposed a technique to detect tumors from MR images suing fuzzy clustering technique. This algorithm uses fuzzy C-means but the major drawback of this algorithm is the computational time required. This paper also compares the FCM and improved version of FCM.

III. PROPOSE METHODOLOGY





Algorithm for Detecting Brain Tumor -

Step1:- Read the input color or grayscale image.

Step2:- Converts input color image in to grayscale image which is done by forming a weighted sum of each three (RGB) component, eliminating the saturation and hue information while retaining the luminance and the image returns a grayscale color map.

Step3:- Resize this image in to 256 × 256 image matrix. Get histogram equalization image.

Step4:- Computes a global threshold that can be used to convert an intensity image (Step5) to a binary image with a normalized intensity value which lies in between range 0 and 1 and get binarised image.

Step5:-Compute the morphological operation by two matlab command imerode and imdilate and strel with arbitrary shape to get dilated image.

Step 6:- Fill the holes in binary image by command imfill to get filled image.

Step 7:- Label the segmented white regions.

Step 8:- Centroid calculation and plot it.

Step 9:- Segmentation of the part of the centroid with largest area to get segmented tumor.

Step 10:- Feature calculation.

Step 11:- Normalization.

Step 12:- Simulate the neural network using the data.

A. Read Image:

For the implementation of this application we need to have the images of different patients in our database in order to identify their condition. The MRI image is stored along with our main file from various sources. Various class of MRI image is considered.

B. Image Acquisition:

Images are obtained using MRI scan and these scanned images are displayed in a two dimensional matrices having pixels as its elements. These matrices are dependent on matrix size and its field of view. Images are stored in MATLAB and displayed as a gray scale image of size 256*256. The entries of a gray scale image are ranging from 0 to 255, where 0 shows total black color and 255 shows pure white color. Entries between this range vary in intensity from black to white.

For experimental purpose 30 female and 30 male patients were examined, all patients have ages ranging from 20 to 60 years. Their MRI scans were stored in database of images in JPEG image formats.

C. Region Extraction:

It is required to display accurately the position relations of the extracted tumor and brain area from the MRI image which is used for the diagnosis of the brain tumor. We propose a method of extracting the brain tumor area using MRI images. In our method, after a base image is generated from one of slice image in MRI data, Region Growing method is applied to the selected slice image based on the base image. 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 image. Finally, we extracted the area of tumor and brain, and both are visualized in three-dimensional domain simultaneously to understand the position relations of the tumor. 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. To the extracted region

the feature extraction process is applied for the calculation of 5 invariant features: Area, Homogeneity, Contrast, and ASM (Angular second moment) and Entropy.

D. Neural Algorithm:

Many of the advances in neural networks have had to do with new concepts, such as innovative architectures and training rules. It is just as important as been the availability of powerful new computers on which to test these new concepts. At present, the answer seems to be that neural networks will not only have their day but will have a permanent place, not as a solution to every problem, but as a tool to be used in appropriate situations. In addition, remember that we still know very little about how the brain works. The most important advances in neural networks almost certainly lie in the future. Although it is difficult to predict the future success of neural networks, the large number and wide variety of applications of this new technology are very encouraging.

CONCLUSIONS

The paper proposes a method for classification of tumor in a brain image. The main objective of this step is to differentiate the different abnormal brain images based on the optimal feature set. This classification is performed on proton Magnetic Resonance Spectroscopy images. But the classification accuracy results are different for different datasets which is one of the drawbacks of this approach. Experiments are conducted on various real-world datasets and the results concluded that the proposed algorithm yield good results when compared with the other classifiers. The results revealed that the proposed hybrid approach is accurate, fast and robust.

In this review various methods and techniques that are being used to detect the brain tumor from scanned MRI images of brain are evaluated. A comparative study is made of various techniques. After evaluation of well-known techniques it is clearly shown the various methods which can detect the tumor efficiently and provide accurate results. Brain is scanned, that is, MRI image of the brain is obtained which is noise free. This work will be extended for new algorithm for brain tumor detection which will provide more efficient results than existing methods in near future. Computational time will also be considered to compare this technique efficiently.

REFERENCES

[1] Oelze, M.L,Zachary, J.F. , O'Brien, W.D., Jr., (2003) ―"Differentiation of tumor types in vivo by scatterer property estimates and parametric images using ultrasound backscatter" ― , Vol.1.

[2] Devos, A, Lukas, L., (2004) ―"Does the combination of magnetic resonance imaging and spectroscopic imaging improve the classification of brain tumors?", Engineering in Medicine and Biology Society. IEMBS '04. 26th Annual International Conference of the IEEE.

[3] Farmer, M.E, Jain, A.K. (Dec. 2005) ―"A wrapper-based approach to image segmentation and classification‖", Image Processing, IEEE Transactions on journals and magazines.

[4] Gopal,N.N. Karnan, M. ,(2010) ―"Diagnose brain tumor through MRI using image processing clustering algorithms such as Fuzzy C Means along with intelligent optimization techniques" ― , Computational Intelligence and Computing Research (ICCIC), IEEE International Conference.

[5] Joshi, D.M.; Rana, N.K.; Misra, V.M. ,(2010): "Classification of Brain Cancer using Artificial Neural Network "―Electronic Computer Technology (ICECT), International Conference.

[6] Ming niwu, chia-chen Lin and chin-chenchang, (2007) ―"Brain Tumor Detection Using Color-Based K-Means Clustering Segmentation‖" , Intelligent Information Hiding and Multimedia Signal Processing, IIHMSP '07, 3rd International Conference (Nov.).

[7] Hossam M. Moftah, Aboul Ella Hassanien, Mohamoud Shoman, (2010) ―"3D Brain Tumor Segmentation Scheme using K-mean Clustering and Connected Component Labeling Algorithms"‖, , Intelligent Systems Design and Applications (ISDA), 10th International Conference (Dec.).

[8] P.Vasuda, S.Satheesh,(2010) "‖Improved Fuzzy C-Means Algorithm for MR Brain Image Segmentation‖", (IJCSE) International Journal on Computer Science and Engineering,Vol. 02.

[9] T. Logeswari, M. Karnan,(March 2010) ―"An improved implementation of brain tumor detection using segmentation based on soft computing‖", Journal of Cancer Research and Experimental Oncology Vol. 2(1).

[10] Jichuan Shi, (2009) ―"Adaptive local threshold with shape information and its application to object segmentation‖", Robotics and Biomimetics (ROBIO), IEEE International Conference (Dec.).

[11] Ronald G, Stephen A, Kromhout-Schiro S, Suresh K. (2000): "The role of neural networks inimproving the accuracy of MR spectroscopy for the diagnosis of head and neck squamous cell carcinoma." AJNR.

[12] Michael R, Simon K, Nabavi A, Peter M, Ferenc A, Kikinis R. (2000): " Automated segmentation of MR images of brain tumors". Radiology.

[13] Egmont P, De D, Handels H. (2002): "Image processing with neural networks-a review". Pattern Recognition.

[14] Majos C, Julia-Sape M, Alonso J, Serrallonga M, Aguilera C, Juan J, Gilli J. (2004): "Brain tumor classification by proton MR spectroscopy: Comparison of diagnostic accuracy at short and long TE". AJNR.

[15] Li G, Yang J, Ye C, Geng D. (2006): "Degree prediction of malignancy in brain glioma using support vector machines". Computers in Biology and Medicine.

[16] Messen W, Wehrens R, Buydens L. (2006): "Supervised Kohonen networks forclassification problems". Chemometrics and Intelligent Laboratory Systems.

[17] Chaplot S, Patnaik M, Jagannathan N. (2006): "Classification of magnetic resonance brain images using wavelets as input to support vector machine and neural network", Biomedical Signal Processing and Control.

[18] Luts J, Heerschap A, Johan A, Huffel S. (2007): "A combined MRI and MRSI based multiclass system for brain tumour recognition using LS-SVMs with class probabilities and feature selection". Artificial Intelligence in Medicine.

[19] Selvaraj S, Thamaraiselvi S, Selvathi D, Gewali L. (2007): "Brain MRI slices classification using least squares support vector machine". International Journal of Intelligent Computing and Medical Sciences in Image Processing.

[20] Georgiadis P, Cavouras D, Kalatzis J, Daskalakis A, George C, Sifaki K, Ekaterini Solomou. (2008): "Improving brain tumor characterization on MRI by probabilistic neural networks and non-linear transformation of textural features". Computer Methods and Programs in Biomedicine.

[21] Yamashita K, Yoshiura T, Arimura H, Mihara F, Noguchi T, Hiwatashi A, Honda H. (2008): "Performance evaluation of radiologists with artificial neural network for differential diagnosis of intra-axial cerebral tumors on MR images". AJNR.

[22] Ibrahiem M, Ramakrishnan S. (2008): "On the application of various probabilistic neural networks in solving different pattern classification problems". World Applied Sciences Journal.

[23] Anam Mustaqeem, Ali Javed, Tehseen Fatima.(2012) "An Efficient Brain Tumor Detection Algorithm Using Watershed & Thresholding Based Segmentation", I.J. Image, Graphics and Signal Processing.

[24] Dr. Samir Kumar Bandyopadhyay. (Jan 2011) "Detection of Brain Tumor-A Proposed Method "*Journal of* Global Research in Computer Science, Volume 2, No. 1.

[25] Sudipta Roy, Samir K. Bandyopadhyay (June 2012): "Detection and Quantification of Brain Tumor from MRI of Brain and it's Symmetric Analysis", International Journal of Information and Communication Technology Research, Volume 2 No. 6.

[26] W. Cuatico, J.-R. Cho, and S. Spiegelman, (October 1973): "Particles with RNA of High Molecular Weight and RNA-Directed DNA Polymerase in Human Brain" Tumors Proc. Nat. Acad. Sci. USA Vol. 70, No. 10.

[27] M. Schlumpf, W. J. Shoemakert, And F. E. Bloom, (Oct.1977): "Explant cultures of catecholamine-containing neurons from rat brain: Biochemical, histofluorescence, and electron

microscopic studies", Proc. Natl. Acad. Sci. USA .Vol. 74, No. 10.

[28] R. B. Guenther, C. W. Kerbert, E. K. Killian, K. T. Smith, And S. L. Wagner,(December 1974): "Reconstruction of Objects from Radiographs and the Location of Brain Tumors" , Proc. Nat. Acad. Sci. USA Vol. 71, No. 12.

[29] Jun A. Takahashi, Hirotaka Mori, Manabu Fukumotof, Koichi Igarashi§, Michael Jaye, Yoshifumi Odat, Haruhiko Kikuchit, And Masakazu Hatanaka, (Aug.1990): "Gene expression of fibroblast growth factors in human gliomas and meningiomas: Demonstration of cellular source of basic fibroblast growth factor mRNA and peptide in tumor tissues", Proc. Natl. Acad. Sci. USAVol. 87.

[30] Samita S. Andreansky, Bin Het, G. Yancey Gillespie, Liliana Soroceanu, James Markert, Joany Chout, Bernard Roizmant, And Richard J. Whitley (Oct.1996): "The application of genetically engineered herpes simplex viruses to the treatment of experimental brain tumors "Proc. Natl. Acad. Sci. USA Vol. 93.

[31] Arati Kothari, (2012): "Detection and classification of brain cancer using artificial neural network in MRI Images", World Journal of Science and Technology.