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BRAIN TUMOR DETECTION USING IMAGE SEGMENTATION AND CLASSIFICATION

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ABSTRACT— Image processing has an important factor called image Segmentation which is very important and initial step in medical image processing. In this process, image is partition according to distinct region. Processing of MRI scan image is the part of medical field. In this project, we use the patient's MRI scan image to detect the Brain tumor using GUI in MATLAB. Before detection, we remove noise by removal functions and apply some basic concept of image processing including segmentation and morphological operations. This project is implemented in MATLAB software. This proposed method detects exact location of tumor from MRI image. This algorithm could be applied on different MRI scan images. In our purposed model, segmentation algorithm which detect the tumor region. After features are extracted through DWT followed by PCA for reducing features dimensions. Finally, SVM, CNN, Lazy IBK classifiers are applied on it to detect tumor type with high degree of accuracy.

Keywords— MATLAB, segmentation, classification, brain tumor.

I. INTRODUCTION

Brain tumor is a fatal disease throughout the globe which effects brain functioning drastically. Imaging medical is emerging field to diagnose soft tissue disorder. Much recent advancement are made progressively in biomedical field to cope with and diagnose this disease with high accuracy and intensity. In United States, 29 Million people are affected by brain tumor claimed by The National Brain Tumor Foundation (NBTF) for research with mortality rate is around 12 million which is a threatening figure. Both children and adults are invasive towards this fatal disease. Tumor is the synonym of neoplasm which is the division of cells in an uncontrolled and irregular fashion. Tumor creates an imbalance between grey matter, white matter and intracerebral fluid due to intense pressure of excessive tissues. As brain is CPU and main power hub of entire body, any disorder leads to serious trauma and loss of co-ordination in body functions. Tumors can be either malignant (cancerous) or benign (noncancerous). Benign are non-invasive dormant type of effected cells as they do not attack on peripherals tissues. While malignant tissues make their concatenated colonies by invading adjacent tissues. If anchoring cells are affected through tumor then this type refers to GLIOMAS. If tumor cells are distributed in other parts via travelling through blood arteries then this condition refers to METASTSIS, A less fatal, dormant, slow proliferated, which can lead towards cystic formation called as ASTOCYTOMA. There are several modules used to get inner symmetry and patterns via magnetic and radio waves like X ray,

Ultrasound, MRI, CAT, PET, SPECT, and BIOPSY.MRI is 3D biomedical imaging technique which is considered best fitted for its high resolution and clarity for image pre-processing. Moreover, it is most appropriate for soft tissue anatomy like liver, brain tissues, ligaments and tendons. Nowadays K-mean method fuzzy methods, neural networks, atlas methods, knowledge-based techniques, shape methods and segmentation are popular methodologies for classifying MR images. In this paper, we are going to implement SVM method on MRI images for classification of data which is collected from different pathologist. For segmentation watershed and threshold technique is used in a graphical environment, which is more comprehensive and visual for radiologists. Through GLCM statistical information description and detection process becomes convenient and accuracy is found more efficiently. Shubhagi & Hiremath (2014) proposed multiclass SVM classification hierarchy to detect tumour and to provide information about its implement on training phase and addition of new patterns and symmetry in testing phase. In testing phase DAGSVM approach is used. Core objective of SM is to find maximum hyper plane which encounter the problem of Quadratic programming

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optimization. Real problem exists that diagnostic tools can't measure quantitative tumor volume. In described method, real time detection is done on multi spectral analysis, which detects Glioblastoma multiform tumor. In this knowledge engineering is coupled with unsupervised SVM. Hence resulting system functions without human assistance.A.R Kavita et at.(2016) Proposed a system working on principles of feed forward and Radial function based on neural network. It was used to detect growing cystic at early stage.it uses density based homogenous accumulation of clusters and OSTu's segmentation. Perveen & Amritpal (2016) suggested a system through fuzzy c mean and SVM approach in which double skull striping and mid-range stretch was used for enhanced performance. GLRLM Grey Level Run Length Matrix was implemented to describe features more precisely. This model gave 91% accuracy in linear SVM kernel, 83% in quadratic, 87% in polynomial while specificity remains 100% in either means. Animesh Hazra et al (2017) suggested brain tumor detection system performing with three main stages. Firstly, apply pre-processing technique, secondly detect edges of images and in the last part classification performed. In this method, median filter is used as the step of pre-processing. In edge detection segmentation three algorithms are used i.e. canny algorithm for detecting edges and sharp lines Here Gaussian filter is used for noise reduction and better quality. Prewett edge detection is done with help of convolution mask and Sobel EDT for relative gradient magnitude. Except canny, remaining algorithms are used for boundary detection. For segmentation global threshold, variable threshold and multiple threshold is applied. Local and adaptive threshold are also implied. Classification is done via KNN method.

Amruta Hebli et al (2017) suggested DWT for feature extraction for orthogonal and hexagonal support. Further PCA and output from PCA is used for statistical descriptions. it uses SVM classifiers and K fold cross validation for more precise results and avoid any ambiguity. RBF kernel is used for parameter sigma. Linear SVM shows 96% accuracy in training while 100% in testing. Polynomial shows 100% in training while 90% accuracy in testing. RBF SVM kernel was considered best as it showed 100% accuracy in both testing and training phase.

Ishita Maithi & Morisha (2018) proposed HSV colour model to detect brain tumor with extended features. Marker based watershed segmentation is applied along with canny edge detection algorithm in methodology. Hue, saturation and value is extracted from HSV model which is helpful in detection tumor from RGB MR Image. Such model does not work well with binary or Grey level image. Histogram equalization is applied to get dynamic range and enhanced image

II. LITERATURE REVIEW

R.J Ramtek et al proposed KNN for economical and less effort required method. It works well on small datasets but as the system grows its performance is compromised.

Shwetajen et al formulated GLCM technique through which feature extraction got a boon. This specific feature was used on artificial Neuron network. Noramanalina Abdullah et al (2011) used discrete wavelet formation as input of MRI scan as approximate coefficient. He used Daubechies-4 and Haar algorithms. In this maximum distance is created in form of hyperplane. T.Logeswari & M.Karnan (2013) proposed HSOM segmentation in which if current neuron is greater than or equal to winning neuron than that is the resultant suspicious region while the current neuron is calculated through weight vector and winning neuron via variable sigma and neighbouring function. Oo, S. Z., & Khaing, A. S. (2014) suggested marker-controlled watershed segmentation using structuring image and central pixel in erosion process, which is the gradient magnitude of horizontal dimension and vertical resolution of sample underlying. In this method, catchment basins were detected through relief map. S. Janeeth et al (2015) proposed a mechanism of detection. Rajesh C. &Patil (2016) used Meyer's Flooding watershed algorithm by combining maximum entropy method, Otsu's method and KNN. In this method matrix dimension determines the shape of originating structure giving HPF output. A.R Kavita et at. (2016) Proposed a system working on principles of feed forward neural network and Radial function based on neural network.it was used to detect growing cystic at early stage.it uses density based homogenous accumulation of clusters and OSTu's segmentation. Amruta Hebli et al (2017) suggested DWT for feature extraction for orthogonal and hexagonal support.

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IshitaMaithi & Morisha (2018) proposed HSV color model to detect brain tumor with extended features.

III. METHODOLOGY

This study is purposed to detect brain tumor and classify them in two classes. Different algorithms are used to detect the brain tumor. First algorithm is pre-processing of MRI image and after that segmentation is applied on image, after segmentation morphological operations are performed. After detection process, particular image is classified with extraction of features from the image. Different algorithms are used for that purpose

I. Take MRI image as input
II. Removal of noise and converting into grey scale.
III. In order to enhance quality median filter is used.
IV. Segmentation
    a. Threshold
    b. Watershed
V. Morphological operation applied.
VI. Feature extraction by DWT and PCA
VII. Classification through SVM, CNN, Lazy IBK
VIII. Results, Tumor Integration Testing Accuracy

IV. DATA ANALYSIS PROCEDURE

Gray Scale Image

When a patient is scanned by MRI machined then computer acquired MRI image in black and white form. In this black and white form halftone technique is used for that purpose. Halftone technique is used printing newspaper. When we get MRI image on Computer display. Lightness and brightness are directly proportional. Lightness is related to gray while brightness is related to primary colours. Black colour has zero (0) value for R, G, B can be written as 0,0,0 or 00000000 whereas RGB vales are 255 for white colour can be written as 255, 255, 255 or 11111111. 8-bit scheme is used in the binary representation. In gray image darkest point show the absence of transmitted light. So, pre-processing process convert image into gray scale. After conversion, net step is to sharp the image. For this high pass filter is used. The sharp image contrast is enhanced between adjoining areas with minor up and down in brightness or darkness. In purposed method MRI image is converted in to gray scale and using high pass filter all noise removed from image

Median Filter

In order to remove noise median filter is applied on image or signal. Noise is removed by median filter as a digital filtering technique which is non-linear. This filter is used for pre-processing step to improve image for further process. To preserve the edges and removing noise, median filter is proven more effective than convolution. After converting in gray scale in order to enhance the quality median filter is applied. It is nonlinear process for removing noise. In median filter, from specific windows, all pixel's converted to median value by taking median of window. In this process each value of pixel replaces with median value of neighbouring.

Thresh Hold Segmentation

When an image has to converted in binary, segmentation technique is applied for this purpose. In this way, foreground is separated from background partitioning an image into its foreground and background. It separates foreground pixels from background pixels. This process converts an image into different segments to change the representation of an image into meaningful way and easy to understandable. This technique is applied on processed image. It is use to separate objects, boundaries and curves from image.

Water Shed Segmentation

This is another image segmentation technique. This is the region base technique which in only applied or work with grey scale image. Watersheds are generated with adjacent basins as a result of this technique (flooding process) on gradient image. For example, along the edges of image basin should raise as a result. Here are different functions are applied like, compute segmentation function, compute background and foreground of image, compute watershed transforms and modify segmentation function. After thresh holding watershed algorithm are applied on image.

Morphological Operation

This is image processing operation which is based on shape of image, value of each pixel as a resulted image is generated with the help of its neighbours (windows neighbour). A morphological operation generates a new image in form of binary where the pixel has a non-zero value. Value is

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depending on the test result. In morphological operation we detect exact position and size of tumor. Matrix dimension specify size of structuring element. Ones and zeros patterns specify shape of structuring element.

Feature Extraction

After detection process, next step is to extract features. There are two algorithms which are used to extract features from image. First one is DWT (Discrete Wavelet Transform) and second one is PCA (Principle component analysis). Both are used to extract features. DWT is used to extract coefficient of wavelets from brain MR images. According to classification, frequency information of signal function is important which is getting by wavelet localizes. CA is used to reduce the large dimensionality of the data. PCA computes the Eigen vectors of the covariance matrix and approximates it by a linear combination of the leading eigenvectors. There are different features which are extracted from image like

- Contrast
- Correlation
- Energy
- Homogeneity
- Kurtosis
- Mean (average)
- Standard Deviation
- Entropy
- Root Mean Square (RMS)
- Variance
- Inverse Difference Movement (IDM)
- Skewness
- Smoothness

Classification and Accuracy

Classification is a technique to categorize data into some specific domains or category. Mostly domains are in the form of classes. Classification problem is related to identify unlabelled data in some domain/category according to available information. An algorithm that try to fall incoming data in specific domain. SVM (support vector machine), Lazy IBK and CNN (Convolutional Neural Networks) are different algorithms for classifications. SVM takes the set of feature vectors as input, generates a training model after scaling, selecting and validating, and generates a training model as the output. This training model is then used to classify the image as either benign or malignant based on the features generated from the feature extraction step. Features are extracted from image by DWT&PCA. CNN does not use the features from the feature extraction step to classify the tumor. It uses a neural network generated from the segmented images of training data to classify the tumor. CNN is multilayer perceptron's which is designs to identify two-dimensional image information.

Classification Average Accuracy	% Accuracy
SVM Accuracy	84%
Lazy IBK Accuracy	82%
CNN Accuracy	88%

V.RESULTS

This experiment has been done by P4 IBM having processor 3GHz with two (2) GB RAM. A software Maltab 2019b is use for purposed method. Different algorithms are used for this automated detection of brain tumor which are explained blow

Load MRI Scan Image

In this process run application build in MATLAB software. Input image is browsed available in dataset and upload into the application. Now loaded image in application is ready for pre-processing shown in fig

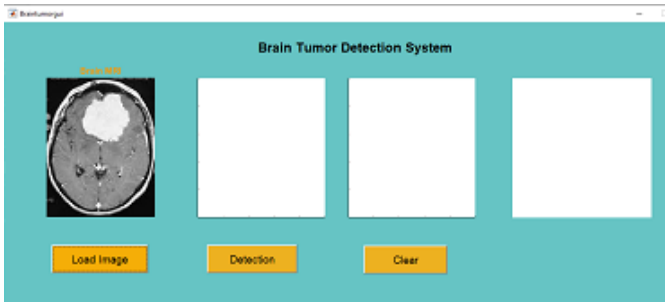

Fig No.1 MRI Scan image in GUI of MATLAB

Converting into Gray scale & Thresh holding

In this process image is converted into gray scale after removal of noise. Thresh holding process is done here on image

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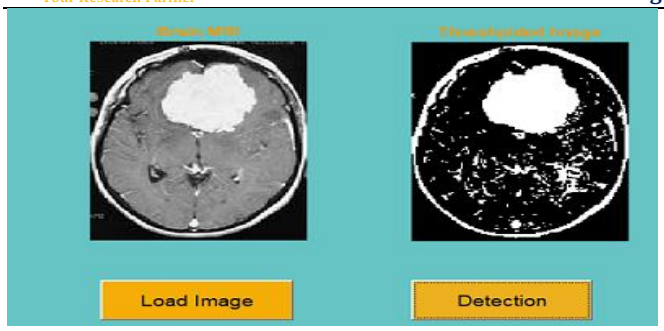

Fig No.2 Gray Scale & Thresh holding Process

Water Shed Segmentation

At this stage watershed process is done on the image. In this process Foreground pixels values separate form background pixels values. This process is done on processed image

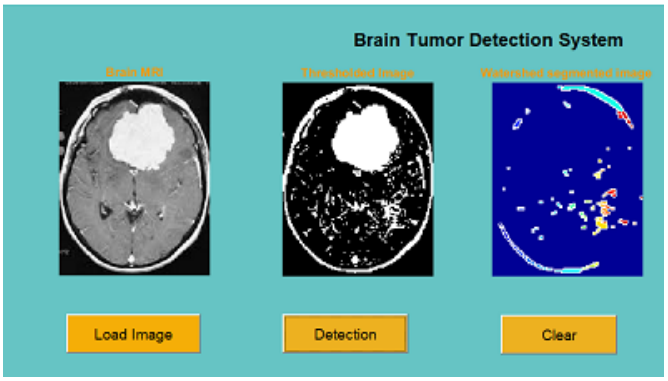

fig No.3 Watershed Segmentation

Morphological Operation

By Morphological operation a new binary image is created. At this stage tumor area detected from processed image show in fig

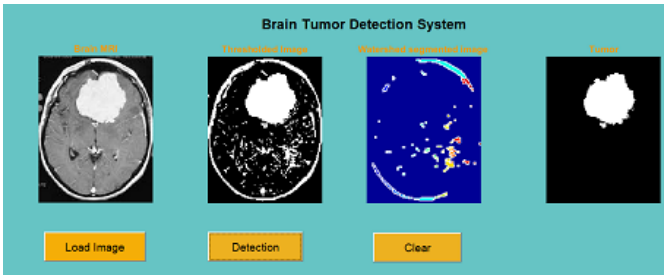

Fig No.4 Morphological Operation

Feature Extraction

After Detection process Features are extracted form image all statistical values are examined by DWT and PCA. DWT extract information from image like frequency and location information.

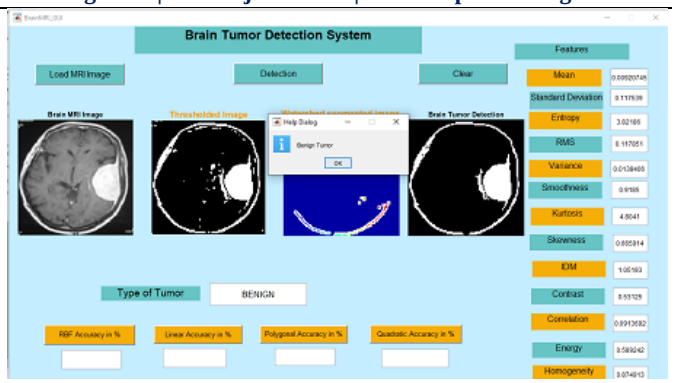

Fig No. 5 Feature Extraction & Classification

Classification and Accuracy

Different images from dataset are trained by SVM either the tumor is normal or in abnormal form. Different algorithms are trained with SVM&CNN.

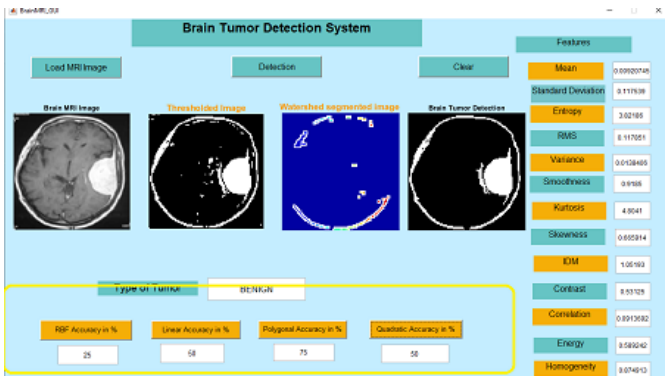

Fig No.6 Classification & Accuracy

VI.DISCUSSION

System is tested and trained on 50 -60 MRI images of normal and abnormal brain tissues taken from different laboratories. Median and Gaussian filters are used for better visibility and clarity. GLCM is used for feature extraction instead of DWT, GLRLM and Gradient Magnitude Histogram as it describes the minute details with enhanced provision of structural and statistical features. For segmentation, watershed segmentation is used as it reduces the time loss for skull stripping and boundary and edges are highlighted in reasonable time slot. For classification SVM is applied for classification as it works well on small datasets in less computational time and high precision compared to other techniques. Different SVM kernels are used for relative comparison analysis as RBF, Linear and polynomial. RBF gives up to 75% accuracy which is far better than other kernels. More accurate results can be obtained by integrating artificial intelligence and training via unsupervised classifiers

VII. CONCLUSION

In this methodology, we classify the brain tumor with the help of image processing techniques including grayscale image, filter, threshold and segmentation. By processing these techniques we identify the location of tumor. Number of features are extracted including correlation, contrast and energy. These features are helpful in classification task of image. In the last classification and accuracy task is performed by SVM and CNN. By adopting this algorithm, we get correct results. We have trained different algorithms and but this method is useful to distinguished normal or abnormal MRI image.

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REFERENCES

Oo, S. Z., &Khaing, A. S. (2014).Brain tumor detection and segmentation using watershed segmentation and morphological operation. *International Journal of Research in Engineering and Technology*, *3*(03), 367-374.

Hassan, E., &Aboshgifa, A. (2015). Detecting brain tumour from MRI image using matlab GUI programme. *International Journal of Computer Science & Engineering Survey (IJCSES)*, *6*(6).

Devkota, B., Alsadoon, A., Prasad, P. W. C., Singh, A. K., &Elchouemi, A. (2018). Image segmentation for early stage brain tumor detection using mathematical morphological reconstruction. *Procedia Computer Science*, *125*, 115-123.

Mathew, A. R., &Anto, P. B. (2017, July).Tumor detection and classification of MRI brain image using wavelet transform and SVM. In *2017 International Conference on Signal Processing and Communication (ICSPC)* (pp. 75-78). IEEE.

Gurbină, M., Lascu, M., &Lascu, D. (2019, July).Tumor Detection and Classification of MRI Brain Image using Different Wavelet Transforms and Support Vector Machines. In *2019 42nd International Conference on Telecommunications and Signal Processing (TSP)* (pp. 505-508).IEEE.

Zhang, Y. D., & Wu, L. (2012). An MR brain images classifier via principal component analysis and kernel support vector machine. *Progress In Electromagnetics Research*, *130*, 369-388.

Vaishnavee, K. B., &Amshakala, K. (2015, March). An automated MRI brain image segmentation and tumor detection using SOM-clustering and Proximal Support Vector Machine classifier. In *2015 IEEE International Conference on Engineering and Technology (ICETECH)* (pp. 1-6). IEEE.

Shree, N. V., & Kumar, T. N. R. (2018). Identification and classification of brain tumor MRI images with feature extraction using DWT and probabilistic neural network. *Brain informatics*, *5*(1), 23-30.

Bahadure, N. B., Ray, A. K., &Thethi, H. P. (2018).Comparative approach of MRI-based brain tumor segmentation and classification using genetic algorithm. *Journal of digital imaging*, *31*(4), 477-489.

Hazra, A., Dey, A., Gupta, S. K., & Ansari, M. A. (2017, August). Brain tumor detection based on segmentation using MATLAB. In *2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS)* (pp. 425-430). IEEE

Gupta, G., Kaur, R., Bansal, A., &Bansal, M. (2014). Analysis and comparison of brain tumor detection and extraction techniques from MRI images. *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization)*, *3*.

Preetha, R., & Suresh, G. R. (2014, February). Performance analysis of fuzzy c means algorithm in automated detection of brain tumor. In *2014 World Congress on Computing and Communication Technologies* (pp. 30-33). IEEE.

Joseph, R. P., Singh, C. S., &Manikandan, M. (2014).Brain tumor MRI image segmentation and detection in image processing. *International Journal of Research in Engineering and Technology*, *3*(1), 1-5.

Logeswari, T., &Karnan, M. (2009). An improved implementation of brain tumor detection using segmentation based on soft computing. *Journal of Cancer Research and Experimental Oncology*, *2*(1), 006-014.

Arunkumar, N., Mohammed, M. A., Mostafa, S. A., Ibrahim, D. A., Rodrigues, J. J., & de Albuquerque, V. H. C. (2020). Fully automatic model- based segmentation and classification approach for MRI brain tumor using artificial neural networks. *Concurrency and Computation: Practice and Experience*, *32*(1), e4962.

Oo, S. Z., &Khaing, A. S. (2014).Brain tumor detection and segmentation using watershed segmentation and morphological operation. *International Journal of Research in Engineering and Technology*, *3*(03), 367-374.

Amarapur, B. (2020). Computer-aided diagnosis applied to MRI images of brain tumor using cognition based modified level set and optimized ANN classifier. *Multimedia Tools and Applications*, *79*(5), 3571-3599.

Kaur, P., Singh, G., &Kaur, P. (2020).Classification and Validation of MRI Brain Tumor Using Optimised Machine Learning Approach. In *ICDSMLA 2019* (pp. 172-189).Springer, Singapore.

Jain, S. (2013). Brain cancer classification using GLCM based feature extraction in artificial neural network. *International Journal of Computer Science & Engineering Technology*, *4*(7), 966-970.

Logeswari, T., &Karnan, M. (2010, February). An enhanced implementation of brain tumor detection using segmentation based on soft computing. In *2010 International Conference on Signal Acquisition and Processing* (pp. 243-247). IEEE.

Hebli, A., & Gupta, S. (2017, December). Brain tumor prediction and classification using support vector machine. In *2017 International Conference on Advances in Computing, Communication and Control (ICAC3)* (pp. 1-6). IEEE.

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