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DETECTION OF BRAIN TUMOR FROM MRI IMAGES USING MACHINE LEARNING

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Abstract: The segmentation, detection, and extraction of tumor area from magnetic resonance (MR) images is the foremost concern but a slow and time consuming task performed by radiologists and their precision depends on their proficiency only. So, the use of computer aided technology becomes very requisite to overcome these hindrance. This work emphasize to revamp the performance and to minimize the complexity in the medical image segmentation process, here we have used x-y segmentation were this method works on the symmetrical property of brain. Furthermore, to revamp the precision and quality rate of the support vector machine (SVM) classifier, a Random forest classifier has been implemented for which features are extracted from each segmented tissue. Based on precision the experimental results of proposed technique have been evaluated and validated for performance and quality analysis on magnetic resonance brain images. By demonstrating the effectiveness of the proposed technique for identifying benign and malignant tumor from brain MR images, the experimental results achieved precision for SVM over random forest respectively. A new method of survival rate prediction using multiple linear regression is also implemented which gives the percentage of improvement of a patient if proper medication is followed.

Keywords: MRI Images, kovesi filtering, X-Y segmentation, Feature Extraction, Machine learning, Randomforest classifier, Multi linear regression.

1. INTRODUCTION

Brain tumor is classified as one of the deadliest disease and also the rate of survival or the rate of recovery is unknown. This work emphasizes on segmentation of brain tumor, training and testing the segmented region using machine learning and then detecting the survival rate of patient as well as evaluating the progressive nature of treatment using machine learning methods. Brain is the main portion of our body, where the memory, emotion, and control of whole body are centered. Hence, the occupancy of tumor in the brain causes problem for the normal functioning of the body. The tumor can paralyze the major areas of brain. Tumors are the undesirable development of brain tissues in the skull. Brain tumor is one of the deleterious disease for human being. The tumors are of two types benign or malignant. The malignant tumor spread rapidly, entering other tissues of the brain and leads to cancer while benign tumor behaves like a normal tissue which does not spread and is not cancerous. The research considers that the detection of brain tumor by system is an easy and efficient way which doesn't consume much time. The image is properly analyzed and produces an accurate outcome. Once the image is loaded it undergoes several paces such as filtering, segmentation, and feature extraction and survival rate prediction. The outcome of each step is served as an input to the next step. Once the images undergo all of these steps, the resultant image specifies if the brain is affected by tumor or not. If the image is affected by tumor then the survival rate is obtained.

In the field of medical diagnosis systems, Magnetic resonance Imaging (MRI), is preferable than Computed Tomography (CT), because Magnetic resonance Imaging provides greater contrast between different soft tissues of human body. Among several imaging techniques magnetic resonance imaging (MRI) is gold accepted truthful modality. Brain MRI image helps radiologists to evaluate the brain. To determine the presence of tumor in the brain the MRI technique is most effective. For classification of brain MR image the supervised machine learning algorithm is used. Using machine learning algorithms i.e. SVM and Random forest has been proposed for the tumor detection. Then the survival rate of a person is determined using multi linear regression.

2. RELATED WORK

In this paper, Magnetic Resonance Images, is been pre-processed by using bilateral filter to reduce the noise and to maintain the edges among the different tissues. Four different techniques used for Morphological operations has been applied to extract the tumor region. The extracted tumor regions area has been calculated. The empathy of the brain tumor using normalized scatter diagram and rupture by using K-means clustering algorithm [1].

In this paper using pixel based division technique the tumor is removed naturally in MR Images. In this division, upgrade and marshalling steps are included. To extricate the improved pictures are dispense and ordered by marking pictures into anomalous and ordinary. The various MRI tests is accomplished. Segmentation technique is not drab, it requires very less time to generate tumor area measurement[2].

Using machine learning (ML) methods the glioma brain tumor by classifying the patients MRI image is automatically predict the survival rate of patients. The dataset is classified into three classes: long-term, mid-term, and short-term. For improving the prediction results and various ML methods are trained and various types of features were extracted [3].

In image processing isolating an image into mutually exclusive regions is one of the method of automatic segmentation. The processing of brain MRI images, segmentation is considered as the very important and essential step because of the diverse image content, object texture, non-uniform and other issues, artifacts and disordered objects. In this paper, automatic segmentation by anatomy operations is implemented and the result is compared with other segmentation techniques.

The anatomy segmentation is found to be fast and effective in automatic segmentation of brain MR images[4].

The MRI image acquired from the machine is subjected to analysis in this paper. Real-time data is used for the analysis. For removing noise preprocessing step is performed using abundant filters. The feature extractions are performed and the de-noised image is segmented. Using the wavelet transform features are extracted. For classification binary tree support vectors are used where the features are given to the classifier. The process of classification is compared with conventional methods [5].

In this paper they use fusion of medical images (MRI image) and machine learning (SVM) for the classification of the type of brain tumor and diagnosis. SVM classifier mainly classifies the tumor based on the extracted, trained and tested features. The experimental result proves that better performance would be achieved by using fusion based brain tumor detection using machine learning [6].

The experimental result shows that the cluster based mostly segmentation results square measure additional correct and reliable than thresholding and cluster strategies all told cases. To implement an automated tumor classification the image associate degreed processing techniques was used with Probabilistic Neural Network. In 2 stages the Higher cognitive process was performed: GLCM feature extraction victimization and also the victimization Probabilistic Neural Network classification [7].

This paper surveys the processes and techniques utilized as a part of detecting tumor in view of medical imaging results of magnetic resonance imaging (MRI). They find that computer vision based techniques can distinguish tumors nearly at a specialist level in different sorts of medical imagery helping with diagnosing myriad diseases [8].

3. PROPOSED METHOD

The basic mission of this project is to pomp the tumor region and determining the survival rate. Here, we are implementing the system for the revelation of brain tumor from MRI images, By this system the malignant or benign tumor will be detected. The complete system includes preprocessing of MRI by using Kovesi filtering, skull removing, and segmentation by x-y segmentation algorithm, also feature extraction, and linear SVM and RF Classifier implementation by the extracted feature of the MRI. Randomforest Classifier is used and using multi liner regression survival rate or recovery rate is determined.

4. SYSTEM ARCHITECTURE

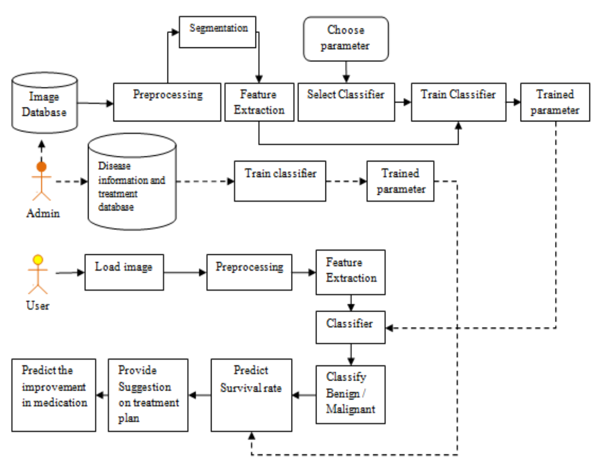

Fig 1: System Architecture

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In The system architecture it consists of two parts,

- Admin
- User

Admin:

In this part initially admin load the image database and system processes the image with preprocessing step. The preprocessing step includes skull masking, skull removal, filtering (kovesi) and Segmentation(X-Y). After completion of segmentation stage the segmented image is given to the feature extraction. In order to select the classifier selected parameters are chosen from feature extraction and the extracted features from the image are given to the classifier in order to train classifier and parameter. Secondly admin load disease information and treatment database to train classifier and parameter. Trained parameter is used to predict the survival rate.

User: In this part user load the brain MRI image of the patient and procedure continued same as in the admin part up to the feature extraction. Classifier consists of feature extraction and trained parameter from the admin part so that it is possible to distinguish it as malignant or benign. After the classification, survival rate is predicted by comparing the obtained results with the admin which consisting of disease information and treatment data base. By the comparison it provides suggestion on treatment plan that helps to predict the improvement in medication.

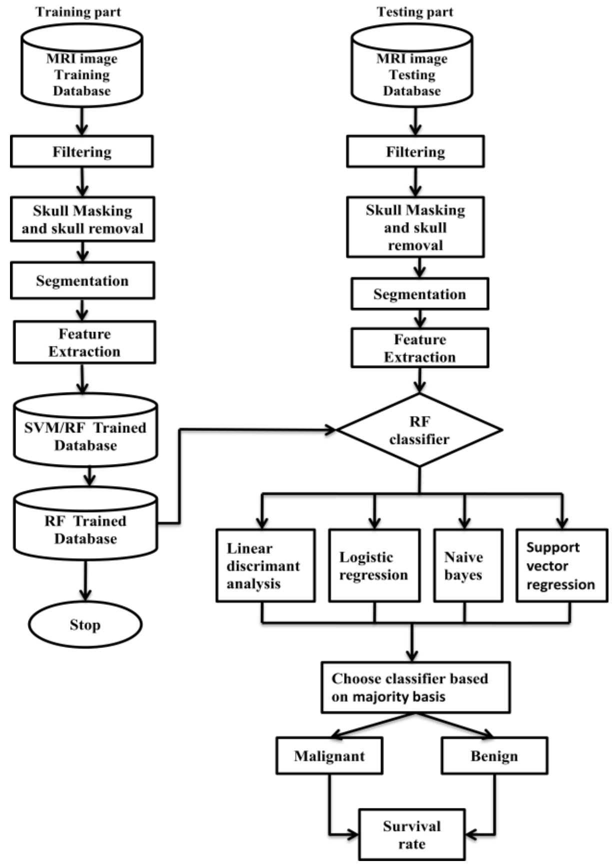

Fig 2: Flow diagram

4.1 Preprocessing:

Pre-processing is used for manipulation on images at the lowest point of cogitation. Preprocessing improves the data present in the image that enhance the features from the images which are necessary for additional processing.

- For the selected images, the following preprocessing steps are applied.

- RGB to gray conversion
- Skull masking
- Skull removal
- Filtering

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In MR image, If the image is colored image then the colored image is converted to gray image by RGB to gray scale image converter. MR image consists of both skull and brain tissue region. Usually the tumor will be found in brain region. Skull masking and skull removing is a process of converting the skull part into whiter region and removing the skull in the MRI brain images. Kovesi filtering method is used and it is a part of wavelet filter. Basically this filtering is used for enhancement of an image which is based on histogram equalization. Image filtering can be done with moving average filters both the problem with it is, it can be done for small fixed width and also dependant on filter size. But Kovesi filtering is a filter with known average estimation of 'K' image filtering where filter size is based on an average and it combines both frequency and time parameters, frequency estimation provides where or which frequency filtering is required so as to decide the weights and time domain tells what should be the size of the weights.

4.2 Segmentation:

Segmentation is the process of segregating an image into several portions. The objective of autopsy is to change narration of image into the image which is easier to analyze. This is used to recognize objects or other momentous information in digital images. There are vast ranges of advents to perform image segmentation. Here, we use X-Y segmentation method for segmenting the images that depict brain tumor.

X-Y Segmentation: Since the brain is symmetrical we could divide brain into two parts. Name one part as X and other as Y. Then we start comparing each pixels of one part with other from the edges to the center. When we are comparing if we find large differences between X and Y parts then we can say that this is the region where the tumor is present and it will be marked.

4.3 Feature Extraction:

When input to an contrivance is very hefty and bombastic to be processed, it is switched into truncated depictive group of features called feature vector. Input data is transformed into set of features is called feature extraction. In this trace, the important features are extracted for image classification. The brain MR image is segmented and is used for extracting texture features which determines the texture property of the image. Gray Level Co-occurrence Matrix (GLCM) method is used for extracting the features which is sinewy method with high fruition. As GLCM uses small number of gray levels shortens the GLCM size that diminishes gauge cost of the contrivance hence GLCM method is very combative for extracting texture feature and also stores the high allotment rates. The GLCM features are required to differentiate between normal and abnormal brain. Texture includes some important illumination about surface structural setup and features depends on gray-tone spatial dependencies that has a basic applicability in image allotment.

The GLCM extracts the textural features are explained in the following:

1. Contrast: This feature measures the contrast of image and is intended as

$C_{on} = \sum_{n=0}^{Ng-1} n^2 \{\sum_{i=1}^{Ng} \sum_{j=1}^{Ng} p(i,j)\}$ ……….. (3.1)

2. Correlation: This feature exhibits the linear addiction of grey levels on the nearby pixels. Equation intends the interaction between the two volatiles in analytical terms.

$$C_{orr} = \frac{\sum_i \sum_j (ij) p(i,j) - \mu_x \mu_y}{\sigma_x \sigma_y}$$ ……………. (3.2)

3. Homogeneity: This feature assigns to the consistency of the density or intensity in the field of the contusion.
$\sum_{i=0}^{m-1} \sum_{j=0}^{n-1} f^2(i,j)$…………………(3.3)

4. Energy: This feature can be defined as the perceptible bulk of the duration of pixel brace repetitions. Energy is a specification to measure the affinity of an image. If Haralicks GLCM feature defines the energy means then it is indicated as angular second moment is expressed as

$$En = \sqrt{\sum_{i=0}^{m-1} \sum_{j=0}^{n-1} f^2(i,j)}$$ ……………. (3.4)

5. Inverse Difference Moment (IDM): This feature epitomize the image smoothness. Image pixel consisting of peculiar gray levels retain less IDM.

$$IDM = \sum_i \sum_j \frac{1}{1+(i-j)^2} \; p(i,j)$$ ……………. (3.5)

6. Mean (M): The average is obtained by summing all the pixel values present in the image divided by the total number of pixels in an image.

$$M = \left(\frac{1}{m \times n}\right) \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} f(i,j)$$ ……………. (3.6)

7. Standard Deviation (SD): The standard deviation characterizes the probability dissemination of an recognized community and it is delivered as a measure of heterogenous. Higher value represents high contrast of edges and better intensity level of an image.

$$SD(\sigma) = \sqrt{\left(\frac{1}{m \times n}\right) \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} (f(i,j) - M)^2}$$ .. (3.7)

8. Entropy: The random distribution of an image gray level is indicated by entropy.If the distribution of gray level is high means then entropy is high.

$$E = -\sum_i \sum_j p(i,j) \log(p(i,j) - \mu)^3$$ ………… (3.8)

9. RMS: The square root of the mean value of the signal calculates the RMS value of a signal x.

$$x_{RMS} = \sqrt{\frac{1}{x} \sum_{n=1}^{N} |x_n|}$$ ……………………… (3.9)

10. Variance: In the MRI image gray level protracted is measured by Variance.

$$\sigma^2 = \sum_i \sum_j (i-\mu)^2 p(i,j)$$ ……………. (3.10)

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11. Smoothness: The contingent smoothness of intensity in a territory is measured by smoothness. Smoothness is high for the suburb of perpetual fury in the values of its fury levels and is low for suburb with large expedition.

12. Kurtosis: Emaciated or languor of information relative to the normal dissemination is measured by kurtosis.

$$K_{urt} = \frac{1}{\sigma^4}\sum_i \sum_j (p(i,j)-\mu)^3 - 3 \quad \cdots\cdots\cdots\cdots (3.11)$$

13. Skewness: The Equilibrium is measured by skewness and is given by

$$S_k = \frac{1}{\sigma^3} \sum_i \sum_j (p(i,j)-\mu)^3 \quad \cdots\cdots\cdots\cdots (3.12)$$

Classification: Support vector machine is associated with linear learning algorithm. In machine learning,it is a supervised algorithm. The classification process is done through training and testing.

Its linear function is expressed as

f (x) = wT X + b ··············· (3.14)

Where, Xi is the training samples that produce two classes by drawing hyper plane between classes.

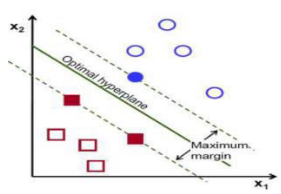

Fig 3: Finding an optical hyperplane.

Random Forest:

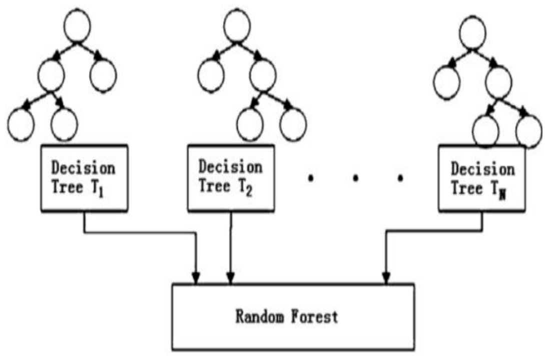

Fig 4: Random forest Feature Extraction

Random Forest is a tensile, uncomplicated to use machine learning algorithm that makes, a significant result most of the time. Random Forest is a supervised learning algorithm. It is one of the techniques which is relevant for a extremely large dataset. A binary decision tree is an outstanding tool, when the task is to precisely learn a certain intricate pattern. For instance, it can reproduce every little detail of any MRI volume applied as training data, while keeping the maximum depth below one hundred. However, this excellent property drags along a serious hazard of over fitting. Learning all the minute details of the train data builds a serious hurdle for the decision tree in making correct decisions concerning important properties of the test data. It built forests of binary decision trees using randomly chosen subsets of the learning data and randomly chosen subset of features for each tree separately. Each tree in a random forest is a weak classifier such as linear discriminant analysis, logistic regression, naive bayes and support vector regression. A large set of trees trained and tested with randomly chosen data will make a single decision on a majority basis.

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5. SIMULATION RESULTS

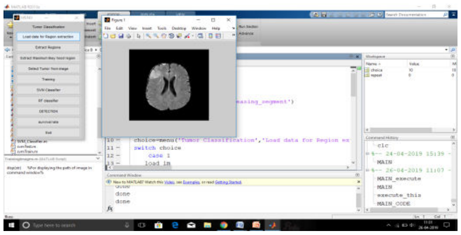

Fig 4: Loaded data for region extraction.

The figure shows the loaded original image (it maybe of color or gray scale images).This is the image which acts as input for the system.

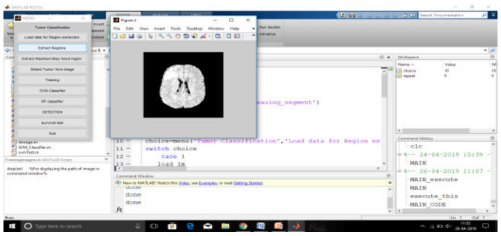

Fig 5: Extraction region of interest.

The figure shows the extracted region of interest, here region of interest represents the skull (provides a protective cavity for the brain) part in the original image.

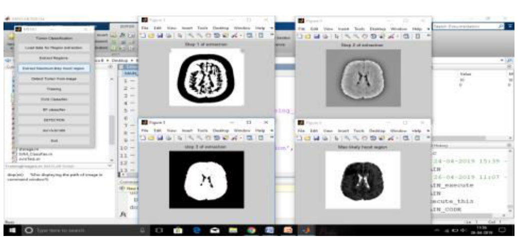

Fig 6: Extraction of Maximum likely hood region.

The figure shows the step by step detailed extraction of maximum likely hood region, which helps in estimating parameters for image extraction.

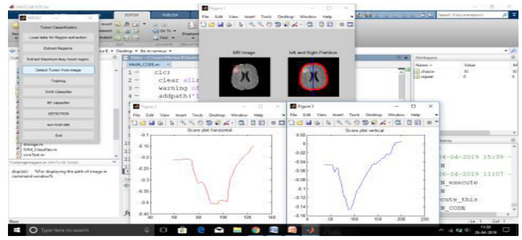

Fig 7: Detection of the tumor region.

The figure shows the detected tumor region in an image by considering scale plot horizontal and vertical, which is obtained by image segmentation.

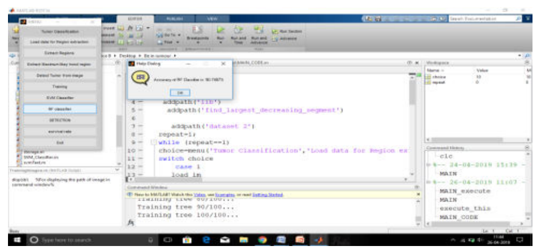

Fig 8: Accuracy of RF classifier.

The figure shows précised output rate obtained by using RF classifier.

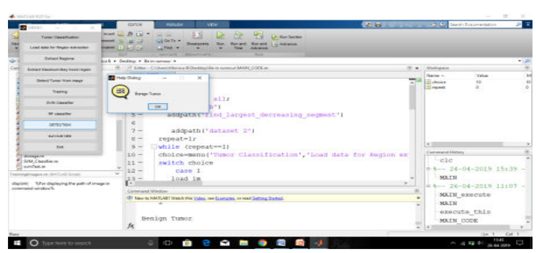

Fig 9: Detection of type of tumor.

The figure shows the type of tumor (Malignant or Benign) detected from the given input or original image by considering training images stored in admin data base.

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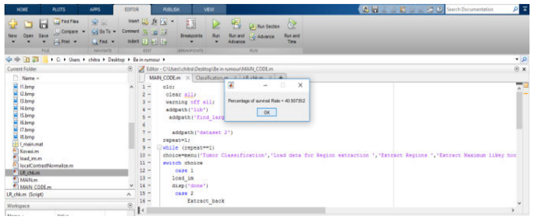


Fig 10: Prediction of survival rate.

The figure shows the recovery rate of a person, which gives how effectively a treatment can cure a person.

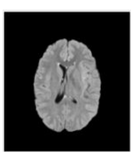
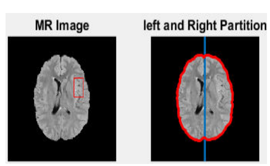
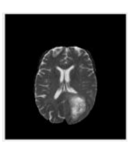
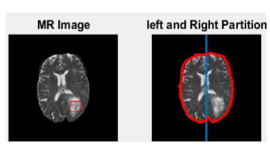
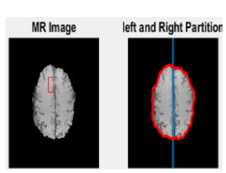
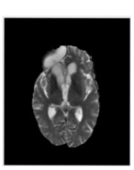
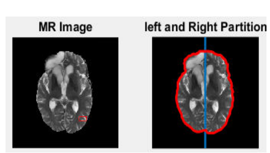
Input image	Segmented image	Tumor type	Survival Rate prediction
		Benign	73.404
		Malignant	21.033
		Benign	73.967
		Malignant	21.059

Table 1: Tested Various Brain Image Results

5. CONCLUSION

The goal of this work was to determine how efficiently a tumor can be detected from a MRI image and can be classified into benign and malignant tissue, in order to do some preprocessing steps were carried out which followed skull removal and segmentation. Random forest and SVM classifier were used as the classifier which were trained to learn the features and finally used to classify. During training it was observed that Random forest performed as a better classifier hence was used Random forest as a classifier to classify the image into benign and malignant and multi linear regression for determining the survival rate.The novelty of the present methodology is that it can detect the tumor in very quick time hence aiding the clinicians to perfect their diagnostic skills. The dataset used is from the publically available dataset hence any dataset can be used to find the efficiency of proposed algorithm which is 90%.

6. FUTURE ENHANCEMENT

Any methodology has scope for improvement, the present methodology is seemed to perform better when we consider preprocessing, while the performance could get effected with feature extraction hence feature extraction based on frequency domain could be carried out such that both spatial and frequency domain features can be considered . Also with more number of data a fuzzy based SVM or fuzzy based neural could be used to predict the degree of randomness in tumor technology in driving situation will be the subject of future work.

7. REFERENCES

[1] **"Brain Tumor Identification Using Bilateral Filtering And Adaptive K-Means Clustering"** by Sushma M and Bharathi D, IEEE 2016

[2] **"Automatic segmentation technique for detection of brain tumor in MRI images"** by Vishal L. Sawant and Pahlavi Kerkar, International Conference on Computing Methodologies and Communication (ICCMC) 2017.

[3] **"Machine Learning and Deep Learning Techniques to Predict Overall Survival of Brain Tumor Patients using MRI Images"** by L. Chato and S. Latifi, IEEE 17th International Conference on Bioinformatics and Bioengineering 2017.

[4] **"Automatic segmentation of brain MRI images and tumor detection using morphological techniques"** by T. D. Vishnu murthy , H. S. Mohana and V. A. Meshram, International conference on electrical, electronics, communication, computer and optimization techniques (ICEECCOT) 2016.

[5] **"A Machine Learning Approach for MRI Brain Tumor Classification"** by Ravikumar Gurusamy and Dr Vijayan Subramaniam, Tech Science Press CMC 2017.

[6] "**Fusion Based Brain Tumor Detection Using Machine Learning"** by Kamali R, Dommaraju Divija, Eduru Madhavi Reddy, Dr. Thilagavathy , International Journal of Scientific Engineering and Research (IJSER) 2018.

[7] "**Segmentation of Brain Tumor in Multimodal MRI using Histogram Differencing & KNN"** by Qazi Nida-Ur-Rehman, Imran Ahmed, Ghulam Masood, Najam-U-Saquib, Muhammad Khan, Awais Adnan, (IJACSA) International Journal of Advanced Computer Science and Applications, 2017.

[8] **"Brain Tumor Region Detection Using Machine Learning Techniques"** by Shalki Gupta M. Rao International Journal of Advance Research in Computer Science and Management Studies Research, September 2018.

[9] **"Detection of brain tumor from MRI images by using segmentation & SVM"** by S. R. Telrandhe, A. Pimpalkar and A. Kendhe, World Conference on Futuristic Trends in Research and Innovation for Social Welfare (Startup Conclave), Coimbatore, 2016.

[10] **"An Experimental Analysis of Fuzzy C-Means and K-Means Segmentation Algorithm for Iron Detection in Brain SWI using Matlab"**, Beshiba Wilson and Julia Punitha Malar Dhas, International Journal of Computer Applications (0975 – 8887) Volume 104 – No 15, October 2014.

[11] **"Pattern Recognition using the Fuzzy c-means Technique"** by Samarjit Das, International Journal of Energy, Information and Communications, February 2013.

[12] **"Detection of brain tumor using neural network"** by V. Amsaveni and N. A. Singh, Fourth International Conference on Computing, Communications and Networking

Technologies (ICCCNT), Tiruchengode, 2013, pp. 1-5, IEEE.

[13] "An Efficient Brain Tumor Detection Algorithm Using Watershed & Thresholding Based Segmentation" by A. Mustaqeem, International Journal of Image, Graphics and Signal Processing, Vol.4, No.10, 2012.

[14] "Brain Tumor Segmentation and its Area Calculation in Brain MR Images Using K-Mean Clustering and Fuzzy C-Mean Algorithm", by Vignesh Rajesh, Bharathan Venkat, Vikesh Karan and M. Poonkodi, Department of Computer Science and Engineering, SRM University.

[15] "A Study of Image Segmentation Algorithms for Different Types of Images", by Krishna Kant Singh1 and Akansha Singh, IJCSI International Journal of Computer Science Issues, Vol. 7, Issue 5, September 2010.