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Brain Tumor Segmentation & Detection of Mr Images Using Intuitionistic Fuzzy Clustering Mean (Ifcm)

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ABSTRACT

This paper focuses on tumor segmentation and detection of MRI brain images using an intuitionistic fuzzy sets method. Now a day, people of all ages are affected by brain tumors because of the uncontrolled growth of tissues in the human brain. This tumor turns into cancer. Segmentation plays an important in detecting different types of tumor, which is developed inside the brain, but in segmentation, it is very difficult which are not properly illuminated. In medical imaging techniques, there are many ways used to detect the location of a brain tumor. Most of them using Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and Positron Emission Tomography (PET) to diagnose a brain tumor. In this paper, identifying the immune cells, that can find the tumor cells and for the segmentation of brain image is used Intuitionistic Fuzzy Clustering Mean (IFCM) algorithm to find the new membership values of the pixels, that Pixel identifies depends on the intensity to attract the neighboring pixel towards its own cluster. The experimental results on brain images to detect the tumor and its size by using the imaging techniques.And to take the intuitionistic fuzzy sets for segmentation using a newly designed formula. Each cluster has membership and non-membership degrees as intervals.

Keywords
Fuzzy c-means, Image Segmentation, Immune Cells, Intuitionistic Fuzzy Clustering Mean (IFCM), Magnetic Resonance Image (MRI)

INTRODUCTION

A brain tumor may be defined as the growth of undesired and uncontrolled cells. It is known very well that the human skull is firm, this undesired cell growth within a restricted area happens to be the cause for a variety of health hazards. These tumors can either be malignant or cancerous. As a consequence of the tumors inside the brain, the pressure inside the brain increases and this can prove to be fatal. The tumors may be of two types namely primary tumors and secondary tumors. Primary tumors are those that originated from the brain whereas secondary tumors are those that were found to be present as a result of the cells that cause cancer in the rest of the body. Genetic inheritance can also be cited as one of the reasons for the growth of extra tissues but this is true only in few cases. Brain tumors may also be the result of a high degree of exposure to radiation and chemicals. The growth of the tumors is relatively slow and in many scenarios proves to be fatal before it is diagnosed. Treatment is given based on several factors namely the type of the tumor, size, location, and the health of the patient. Medical treatment at the early stages of tumor growth can reduce the risk of higher complications. As it is curable if one takes treatment at the early stages he can lead a healthy life. Plenty of research work is present to detect the tumor. The detection algorithm presented in this article is to find the presence of the tumor and provide better results. This article discusses detection at several stages that encompass feature set dimension reduction and immune system training and arrive at better conclusions than the previous algorithms that are in existence [15]. Table I shows the comparison of image techniques

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Table I. Image Technique Comparison

	CT Scan	MRI Scan	PET Scan
Radiation	**Effective radiation**	**None**	**Moderate to high radiation**
Uses	It is used for detecting cancers, bone injuries, and lung or chest.	Excellent for detecting very slight differences in soft tissues.	Production of 3D images by the functions of body parts due to nuclear imaging.
Time	5 or 10 minutes	30 minutes	2 to 4 hours
Cost	Less	Higher	Much higher
Effects on the body	In miniature, CT scan poses the risk of irradiation. painless, noninvasive.	No reports of biological hazards.	Radiation risk from the injection of a radioactive tracer like an X-ray.
Scope of an application	It shows the presence of outline bone very accurately inside the body.	It is used in the examination of a plethora of medical conditions.	The image has used for biological processes within the body.

RELATED WORK

The authors in this article talk about the clustered genetic procedure that is adapted to detect the tumor. Evaluation of brain tumor segmentation using a clustering algorithm is carried out. Filtering is employed to perform pre-processing and fuzzy c means the algorithm does the process of segmentation. In this method, the grayscale (RGB) of the images are scanned and the images are converted to a binary image. Binarization is employed for image conversion and this aids to detect the boundaries of the tumor pixels. The number of white pixels (digit 0) is used in calculating the dimensions of the tumor [4][27].

In this paper, different pre-processing methods are applied to MRI images. The pre-processing makes use of a median filter. The pre-processing is performed so as to eliminate noise and to sharpen the image. Fuzzy c means algorithm and modified fuzzy c means algorithms are the two popular algorithms that are proved to show increased performance to segment the images when applied to detect images. Among the two algorithms stated above modified FCM algorithm is found to perform better in detecting brain tumors [2].

This paper focuses on detecting brain tumors from MRI images. The process is done via the GUI interface that is available in Matlab. Segmentation, filters, and additional image processing techniques are employed to arrive at precise conclusions. The images are filtered using Prewitt horizontal edge-emphasizing filter. Subsequently, the watershed pixels are used in the detection process. The availability of Matlab guide favored in implementing various algorithms in an effort to get reliable results[3].

From this paper, it is evident that results obtained by using the K-Means clustering method showed an increase in efficiency than its counterpart, the Fuzzy C Means method. Fuzzy C Means is a method that needs to be supervised partially. This mandates the need to perform

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preprocessing. K-Means Clustering is an unsupervised method that does not require preprocessing and the number of iterations it requires is less. K-Means technique enables lossless compression to a greater degree. This algorithm presents perfect results even if the data fed as input is lower in number. Hence, it is considered to be efficient and less sensitive to errors[4][16].

Many variants of brain tumor detection algorithms are proposed by several researchers. Every algorithm failed to provide accurate results in tumor detection and image extraction. The segmentation algorithm that employs k-means clustering and fuzzy c-means methods simplified the process of detecting the tumors and were effective in presenting details about the exact location of the tumor. Fuzzy C means algorithms are found to perform with a higher degree of accuracy than their counterparts. The patient's stage is determined by this process, whether it can be cured with medicine or not [5][23][26].

The researchers have made a proposal of two algorithms viz. Multiple kernel fuzzy c means algorithm(MKFCM) and adaptive level set. These algorithms are used for image segmentation. These are used in the process of detecting brain tumors. The MKFCM method combination of the variety of information that is available about the image is done. The author redefined the edge indicator function in their algorithm. Level set procedures are adopted for the evaluation of contours of images and to recover the shape of images. This modified algorithm proved to be very effective in detecting brain tumors[6]

For any brain MRI image, the first step is to enhance the image then the region of interest is detected using the fast bounding box algorithm. Finally, post-processing is performed on the image in an attempt to segment the tumor. As a result of the above steps, it is possible to get a segmented image of the brain [7] [25].

In this paper, two algorithms (k-mean clustering and fuzzy c-mean) are used which may be used to segment the images of the tumor accurately. Besides performing accurately it contributed to the reduction in time that is consumed for analyzing the images. The authors have discussed the comparison of the two algorithms using several parameters. Comparison of the two algorithms is performed using various parameters [8][28].

The weakness of the Fuzzy c Mean algorithm is elaborated in this paper. Although the FCM clustering procedure is simple and the results can be obtained quickly the results obtained are found to lack accuracy. In an effort to increase the efficiency the authors suggested using an ant colony algorithm. With the use of the ant colony algorithm in the two clustering methods, the accuracy and PSNR levels are found to be higher. The authors also suggest carrying out further studies in order to lower the time needed for the ant colony algorithm to process the data[9].

The system has proposed an immune system and KFCM algorithm. Using the immune cells, the growth of the brain tumor cells is found. MRI and PET images are used to find the tumor location and sizes, for the immune system to analyze the development stage of the tumor. The KFCM algorithm is used to identify the small distances in the data point in images. So, the system has discovered that could lead to better treatment for patients suffering from a brain tumor. The imaging technique helps to view the cells in the brain and extract the location of the tumor is detected [10].

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PROPOSED SYSTEM

In this proposed method immune system and Fuzzy Clustering Mean algorithms are used to locate the brain tumor. The process of Segmentation divides the image into several parts that are found to show relative features. As the first step preprocessing of images is done. After preprocessing segmentation of images using clustering techniques is carried out to extract the brain tumor. Figure 1 represents the flow of a process in the proposed method

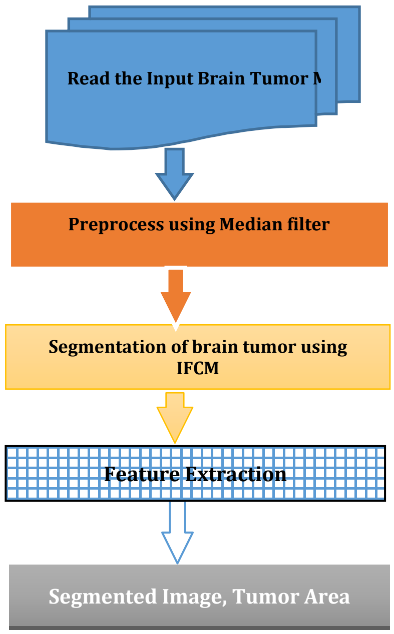

Fig 1: Proposed Method

3.1 Preprocessing using Median Filter

Pre-processing involves using Median Filter. Noise signals in which high-frequency components are present are eliminated without causing any distortion to the boundaries of the image is the result of pre-processing. Preprocessing also helps in reducing "salt and pepper" noise. The median of the pixel values is taken into account so as to figure out fresh values of noise [12][29]. Conversion of the RGB format of the image to grayscale is carried out. Also, the images are subjected to reshaping. The major focus of this research paper is to perform segmentation of the MRI images to employ in tumor detection. Hence the process of noise removal takes a center stage.

3.2 Image Segmentation of Brain Tumor using IFCM:

Segmentation is a procedure that divides the image into several parts. The divided portions of the image are found to exhibit analogous properties namely gray level, color, texture, brightness, and contrast[13][30][31][32]. In an image, each pixel has processed the data as a partial membership in the fuzzy logic, and the value lies between 0 and 1. Basically, the multiple values allow for intermediate values i.e., the same image in a fuzzy set one member can also be a member of the other.

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Intuitionistic Fuzzy Clustering Mean (IFCM) Algorithm

Chaira [14] has developed an Intuitionistic Fuzzy c-Means (IFCM) algorithm that uses the concept of intuitionistic Fuzzy set. It is a set of membership and non-membership observations their sum is divided by the number of observations, for example, the intuitionistic fuzzy mean x of n membership $\mu(x)$ and non-membership $\gamma(x)$ observations. The MR Images in brain tumor assume that Xis a space of points, a fuzzy set $A = \{(x, \mu(x), \gamma(x)) | x \in X\}$ is represented as membership function $\mu(x)$, where xdenotes an element of X. Here, we have to take the intuitionistic fuzzy sets to newly design the formula for ordinary intuitionistic fuzzy arithmetic mean. Each cluster has membership and non-membership degrees as the interval [0, 1].

In this proposed work the Intuitionistic Fuzzy C – means algorithm is used to divide the set of pixels into C fuzzy clusters $X = \{\mu_{x1}, \mu_{x2}, \mu_{x3}, \dots \mu_{xn}\}$, where each point belongs to the cluster. It allows a point based on more number of a cluster as it is in membership value.

The prime purpose of IFCM is to lessen the objective function as shown in the equation:

$\mu_{x1}, \mu_{x2}, \mu_{x3}, \dots \mu_{xn}$ [Membership values] and

$\gamma_{x1}, \gamma_{x2}, \gamma_{x3}, \dots \gamma_{xn}$[Non-Membership values] is given by

$$\sum_{i=1}^{n} \mu_{xi} = \mu_{x1} + \mu_{x2} + \mu_{x3} + \dots + \mu_{xn}$$

$$\sum_{i=1}^{n} \gamma_{xi} = \gamma_{x1} + \gamma_{x2} + \gamma_{x3} + \dots + \gamma_{xn}$$

$$X = \frac{1}{2n} \sum_{i=1}^{n} [(\mu_{xi} + \gamma_{xi})]$$

$$X = \frac{1}{2n} [\sum_{i=1}^{n} \mu_{xi} + \sum_{i=1}^{n} \gamma_{xi}]$$

$$X = \frac{1}{2n} \sum [(\mu_{xi} + \gamma_{xi})]$$

3.3 Feature Extraction

Feature extraction is a procedure that is carried out to reduce the number of data that is available and eliminate redundant data. Based on the input data it will transform into a reduced representation set of features. It helps to identify the precise location of brain tumors. Having known the exact location it is possible to predict the next stage of the disease.

3.4 Segmented Tumor Area

The input is chosen to be the area where the tumor was identified. This algorithm calculates the precise area where the tumor is present.

1. Read the input image.
2. Perform color to grayscale conversion.
3. Compute the numbers of rows(r) and column(c) in pixels.
4. Initialize the center of the cluster.
5. Check whether the cluster value is equal to 255.
6. If the pixel region is present at the center, go to the same cluster otherwise move to a subsequent cluster.
7. Reposition the central point of the cluster.
8. Repeat until the process calculates the distance between each pixel and cluster center of row and column.
9. Display the segmented tumor size.
10. Stop the process.
11.

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EXPERIMENTAL RESULT

4.1 Dataset

Performance analysis of the segmentation of brain tumors is carried out on the basis of IFCM clustering. The Brats2017 dataset consists of an MRI image of size 181X272 that employed a segmentation technique. It consists of 40 MRI brain images in which it identifies 25 as with tumor and 15 as without tumor. Figure 2 represents that the training dataset is used to pre-process the image in IFCM which is used to identify the location.

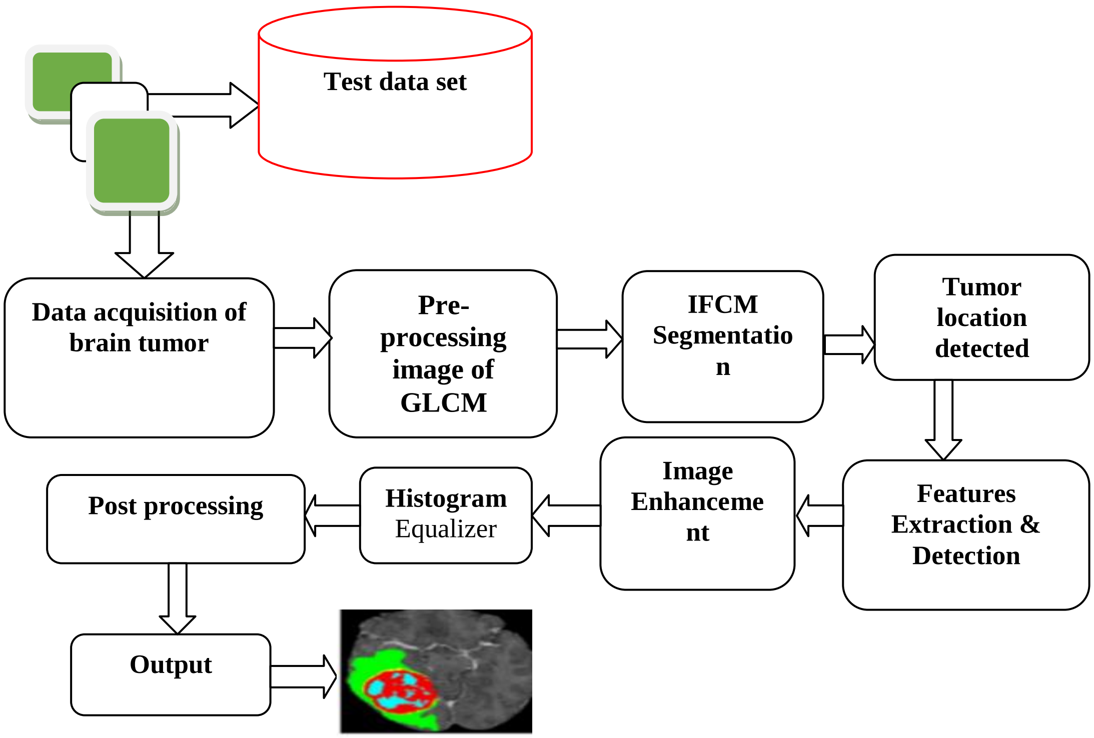

Fig:2 Architecture of Process

4.2 Input Image

The role of color in images is crucial in the study of cells. The boundaries are easily understood in colored images especially in complex images. The red-green and blue-yellow color contrasts of the human visual structure serve as the basis for a majority of color perception chores. One area of the application of the above statement is in detecting the contours of tumors. The background of this research is a hierarchical model that employs a feed-forward mechanism. This is directly opposite to its color counterpart of PET scan. boundary. Figure 3 is an illustration of the image that may be chosen to be fed as an input image on which segmentation is to be performed to detect tumors.

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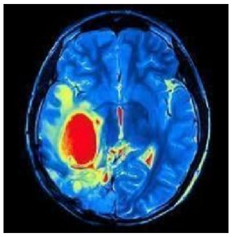

Fig:3 Input image

4.3 Color Conversion

Conversion of RGB image into a grayscale image as shown in fig 4, is a complicated process that may result in losing contrasts, sharpness, shadow, and structure of the color image. The hue and saturation levels are eliminated and the luminance is considered for the process to convert an RGB image into a grayscaleimage[34].

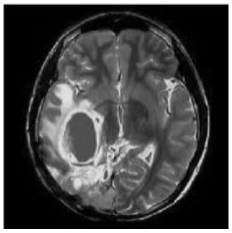

Fig:4 Color Conversion Image

4.4 Edge Detection

The edge detection provides the outline view of the image. Using the image easily identifies the tumor cell or any other patches in the brain. The following image (fig 5) defines edge detection.

Fig: 5 Edge Detection Image

4.5 Image Segmentation

Image segmentation is the process of partitioning an image into multiple segments as shown in fig 6. It is used in the process of simplifying the image representation. Image segmentation makes the process of image analysis simpler [35]. Additionally, it assists in locating the image borders precisely. All pixels of the image are assigned a label to make the process of viewing easier[36].

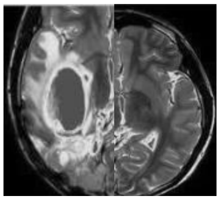

Fig: 6 Left Side Segmentation Right Side Segmentation

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4.6 Image Enhancement

Noise, sharpness, and brightness of the images are eliminated by the process of image enhancement. This makes it easier to identify the key features of the tumor and the exact site of the tumor as shown in fig 7.

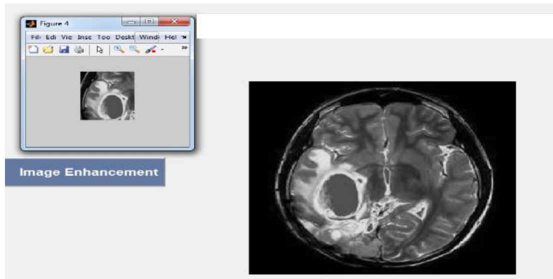

Fig: 7 Image Enhancement

4.7 Performance Analysis

In this research, 100 samples are used to test the tumor. 45 samples convey that there is the presence of a tumor and 55 samples show the nonexistence of a brain tumor. Sensitivity, Positive Prediction Value, Negative Prediction Value, and accuracy are some of the parameters used to analyze the efficiency of the proposed technique. The table below is a representation of the same.

Test	Cases affected by Disease	Cases without Disease
Positive	A	B
Negative	C	D
	Number of patients who suffer from the disease (A+C)	Number of cases who are healthy (B+D)

Sensitivity = A / (A + C) – number of people affected by a brain tumor and showing a positive result.

Specificity = D / (D + B) - number of people not affected by a brain tumor and showing a negative result.

Positive Predictive Value = A / (A + B) - the number of people whose result is positive and were found to have the disease.

Negative Predictive Value = D / (D + C) - the number of people whose result is negative and were found not to be affected by the disease.

Accuracy = (A + D) / (A + B + C + D) – number of people without disease whose result is positive.

Table II : Performance Analysis

Image Sequence	Sensitivity %	Specificity%	Positive Predictive Value %	Negative Predictive Value %	Accuracy%
Image 1	77	68	43	87	95.38

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Image 2	80.50	65.69	25.78	80	94.43
Image 3	75.94	68.58	38.22	85	95.99
Image 4	78.53	70.96	40.83	75	93.33
Image 5	83.87	65.54	50.86	96	98.49
Image 6	89.53	78.82	70.63	91	97.52
Average	80.90	69.598	44.89	85.67	95.86

It helps and saves the precious time of doctors to diagnose the tumor automatically as shown in Fig 8.

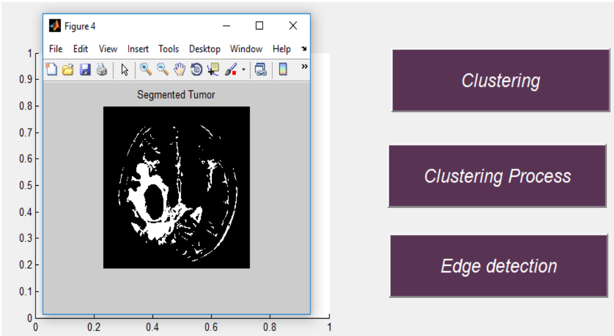

Fig 8 Diagnose the tumour

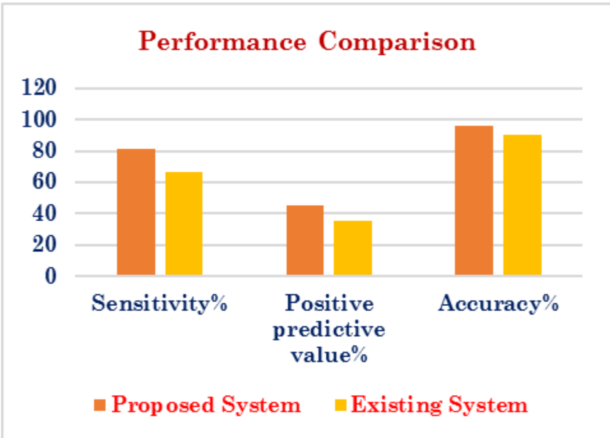

Fig.9 Performance Comparison

CONCLUSION

A new technique is used to improve the Immune system to detect and classify brain tumors. This proposed system provides information about brain tumors by combining the imaging techniques and IFCM algorithm. Image Segmentation tool reduces the complexity in the medical image analysis as easier. Pre-processing gives accurate results, i.e., which eliminates the noise, patch normalization, and unwanted region in the tumor images. The number of training patches is artificially augmented from the samples of PET, CT, and MRI Images. The MICCAI Brats 2017 dataset is used for testing based on the immune system.

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Received 16 February 2021; Accepted 08 March 2021.

REFERENCES

[1] P. Maheswari, K. Sankaragomathy, M. Ramya and B. AnishFathima, "Improved Fuzzy C Means Algorithm Based on Robust Information Clustering for Image Segmentation" Asian Journal of Applied Science and Technology (AJAST) Volume 1, Issue 3, April 2017.

[2] Jeenal I. Patel, Minkal B. Patel, "MRI Brain Image Segmentation Using Modified Fuzzy C-Means Clustering Algorithm" International Journal of Innovative Research in Technology, July 2015, IJIRT, Volume 2, Issue 2, ISSN: 2349-6002.

[3] Esmail Hassan and AbobakrAboshgifa "Detecting Brain Tumour from MRI Image Using Matlab GUI Program" International Journal of Computer Science & Engineering Survey (IJCSES) Vol.6, No.6, December 2015.

[4] Nimeesha K M, Rajaram M Gowda "Brain Tumour Segmentation Using K-Means and Fuzzy C-Means Clustering Algorithm" International Journal of Computer Science & Information Technology Research Excellence Vol. 3, Issue 2, Mar.-Apr. 2013 ISSN NO 2250-2734.

[5] Ashwini A. Mandwe1 , Anisa Anjum2, "Detection of Brain Tumor Using K-Means Clustering ", International Journal of Science and Research (IJSR),Volume 5 Issue 6, June 2016

[6] Mrs. D. Manju1 and K. Pavani "Brain Tumor Detection Using Multiple Kernel Fuzzy C-Means on Level Set Method" International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 3, Issue 4, April 2014 ISSN 2319 – 4847.

[7] RohanKandwal, Ashok Kumar, "An Automated System for Brain Tumor Detection and Segmentation", International Journal of Advanced Research in Computer Science and Software Engineering Research Paper, Volume 4, Issue 3, March 2014 ISSN: 2277 128X.

[8] S. Krithiga, S. SuganyaHepziJeba and KavithaBalamurugan "Brain Tumor Detection Using Fuzzy C Means Segmentation" International Journal of Power Control and Computation (IJPCSC), vol 7. No.2 – 2015 Pp.155-161, ISSN: 0976-268X.

[9] Sayali D. Gahukar, Dr. S.S. Salankar, "Segmentation of MRI Brain Image Using Fuzzy C Means for Brain Tumor Diagnosis" Int. Journal of Engineering Research and Applications ISSN: 2248-9622, Vol. 4, Issue 4, April 2014, pp.107-111.

[10] Ms. S. ShanmugaPriya, Dr. S. Manimekalai "A Review on Brain Tumor Detection Using Immune System with Imaging Techniques" International Journal of Engineering Science Invention. ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726, Vol.3, PP. 20-24.

[11] Saritha A K, Ameera P.M "Image segmentation based on kernel fuzzy C means clustering using edge detection method on noisy images" International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 2, Issue 2, February 2013, ISSN: 2278 – 1323.

[12] Sudipta Roy, Sanjay Nag, IndraKantaMaitra, Prof. Samir Kumar andyopadhyay "A Review on Automated Brain Tumor Detection and Segmentation from MRI of Brain".

[13] Neeraj Sharma and Lalit M. Aggarwal, "Automated Medical Image Segmentation Techniques", Vol. 35, Issue 1, Page 3-14, 2010.

[14] T. Chaira, "A novel intuitionistic fuzzy c means clustering algorithm and its application to medical images," Applied Soft Computing, vol. 11, no. 2, pp. 1711–1717, 2011.

[15] Halder, Amiya&Dobe, Oyendrila. (2017). Rough K-means and support vector machine based brain tumor detection. 116-120. 10.1109/ICACCI.2017.8125826.

[16] Mihai-Virgil Nichita, Maria-Alexandra Paun, Vladimir-AlexandruPaun, Viorel-PuiuPaun.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 3, 2021, Pages. 7669 - 7680
Received 16 February 2021; Accepted 08 March 2021.

"Image Clustering Algorithms to Identify Complicated Cerebral Diseases. Description and Comparison", IEEE Access, 2020
[17] Nita A. Limdi, David L. Veenstra. Expectations, validity, and reality in pharmacogenetics", Journal of Clinical Epidemiology, 2010
[18] He Deng, Wankai Deng, Xianping Sun, Chaohui Ye, Xin Zhou. "Adaptive Intuitionistic Fuzzy Enhancement of Brain Tumor MR Images", Scientific Reports, 2016
[19] TrunalJambholkar, DharmendraGurve,PrakashBabu Sharma. "Application of Empirical Wavelet Transform (EWT) on images to explore Brain Tumor", 2015 International Conference onSignal Processing, Computing and Control(ISPCC), 2015.
[20] S V Aruna Kumar, B S Harish, V N ManjunathAradhya. "A picture fuzzy clustering approach for brain tumor segmentation", 2016 Second International Conference on Cognitive Computing and Information Processing (CCIP), 2016.
[21] T. Sathies Kumar, K. Rashmi, SreevidhyaRamadoss, L.K. Sandhya, T.J. Sangeetha. "Brain tumor detection using SVM classifier", 2017 Third International Conference on Sensing, Signal Processing and Security (ICSSS), 2017.
[22] SobitThapa, Sanjeeb Prasad Panday. "Chapter 12 Analysis of MRI Images for Brain Tumor Detection Using Fuzzy C-Means and LSTM", Springer Science and Business Media LLC, 2021.
[23] Divyata D. Pingale, S. R. Todmal. "Brain Tumor Segmentation Using K-Means and Fuzzy CMeans
[24] Clustering and Its Area Calculation and Stage Using SVM Algorithm", Journal of Advances and Scholarly Researches in Allied Education, 2018..
[25] AzianAzamimi Abdullah, Bu SzeChize, Yoshifumi Nishio. "Implementation of an improved cellular neural network algorithm for brain tumor detection", 2012 International Conference on Biomedical Engineering (ICoBE),2012.
[26] Shivani P. Deshmukh, Prof. Rahul D. Ghongade “Detection and Segmentation of Brain Tumor from MRI Images” International Journal of Engineering Science & Advanced Technology Volume-4, Issue-5, 426-430, ISSN: 2250-3676.
[27] Alan Jose, S. Ravi, M. Sambath “Brain Tumor Segmentation Using K-Means Clustering and Fuzzy C-Means Algorithms and Its Area Calculation” International Journal of Innovative Research in Computer and Communication Engineering, Vol. 2, Issue 3, March 2014.
[28] P.Maheswari , K.Sankaragomathy , M.Ramya and B.AnishFathima,’Improved Fuzzy C Means Algorithm Based on Robust Information Clustering for Image Segmentation’, Asian Journal of Applied Science and Technology (AJAST) Volume 1, Issue 3, Pages 70-74, April 2017
[29] Gupta, Ms&Shringirishi, Ms& Singh, Dr.yashpal. (2006). Implementation of Brain Tumor Segmentation in brain MR Images using K-Means Clustering and Fuzzy C-Means Algorithm. INTERNATIONAL JOURNAL OF COMPUTERS & TECHNOLOGY. 5. 54-59. 10.24297/ijct.v5i1.4387..
[30] Selvanayaki, K,. Dr. P. Kalugasalam, 2012. “Pre-Processing and Enhancement of Brain Magnetic Resonance Image (MRI)” Ijrcm, 2-10.
[31] Gonzalez RC, Woods RE. *Digital image processing.* 2nd ed. 2004. Pearson Education.
[32] Pratt KW. *Digital image processing.* 3rd ed. Willey; 2001. pp. 551–87.
[33] Pal NR, Pal SH. A review on image segmentation techniques. *Pattern Recog.* 1993;26:1277–94.
[34] Kaifu Yang , ShaobingGao , Chaoyi Li, Yongjie, Efficient Color Boundary Detection

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 3, 2021, Pages. 7669 - 7680
Received 16 February 2021; Accepted 08 March 2021.

with Color-opponent Mechanisms, openaccess.thecvf.com

[35] Kendall Preston Jr., Image Processing In Medical Microscopy, IEEE trans action 1986.

[36] Qingsong Zhu, Zhan Song, YaoqinXie, and Lei Wang, ”A Novel Recursive Bayesian Learning-Based Method for the Efficient and Accurate Segmentation of Video With Dynamic Background”, IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 21, NO. 9, SEPTEMBER 2012.

[37] HemaJagadish , J. Prakash, A Novel Method for Homogeneous Region Based Image Segmentation Technique for Remotely Sensed Images, (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (6) , 2015, 5014-5021