

# A Segmentation Approaches to Detect Autism and Dementia from Brain MRI

B.J. Bipin Nair, T.R. Pruthvi

**Abstract---** *Magnetic Resonance Imaging (MRI) and functional MRI (fMRI) studies involving allows to working human brain to be imaged at high resolution within only in a particular time. In our studies fMRI helps in find out the small changes in the brain image and using segmentation algorithm, using segmentation we locate the region in brain MRI and apply any three-efficient segmentation technique checks, and finally predicting which algorithm is an efficient way of doing segmentation the. Basically, so many researches are happened in the disorder like brain tumor, but the present literature says that very less work happened in the disorder like mental and neurodevelopmental disorders. In our proposed work, we are segmenting autism and dementia disorder using MRI image analysis.*

**Keywords---** *Fuzzy C-Means (FCM), K-Means, GT.*

## I. INTRODUCTION

Medical imaging is a way to identify the status of interior body muscle, tissues, and bone, and representation in visually, these visual images help in identifying the damage or unhealthy part then by seeing damages trying to give a solution to that disorder or a problem. In medical imaging, there are MRI (Magnetic resonance imaging), X-Ray, Ultrasound, stenography, thermography and medical photography, nuclear medicine functioning. These are techniques to record and save the report of the patient.

Image processing in MATLAB (Matrix Laboratory) is the one good platform to preprocessing, extraction, restoration, acquisition, and segmentation of the image and MATLAB is numerical computing. Image processing is converted analog image to digital image (with digital filters), in digital image processing extract the useful information from a digital image which is already converted.

Neurodevelopmental disorders are not balanced growth of development of the central nervous system; brain activities influences emotion, abilities of learning, ability to inhibit control, and processing of memory. The neuro developmental disorder is and may chance of ancestral and metabolic diseases, immune problem disorders.

## II. LITERATURE SURVEY

Neerav Karani et al [1] have done a novel study on brain MRI segmentation using the says convolutional neural network. The main provocation in many MR image analysis job, includes segmentation, is durability to comparison in Statistical feature of image intensity. Atlas-based segmentation Batch normalization was used in to activate the swift training of deep neural networks by preventing

saturated gradients, Autism disorder MR image used for segmenting. Histogram filter used to balance the intensity. Job to gear the machine learning issues for CNN's in the medical image analysis condition. Juan Eugenio Iglesias et al [2] analyzed the subregions of the brain MR image such as hippocampus and defined that a computational design built is needed at a higher clarity and complete high resolution than those that are commonly passed down in current neuroimaging process. In this, we explain the development of statistical design of the hippocampus arrangement at the alternate field level taking the heavy high quality of vivo MRI. The Bayesian algorithm is to advance the mesh, which is a model taking issue. All over the remaining of this part, we will assume that all the training examples related to left hippocampus; samples from right hippocampus are jump before being fed to the algorithm. The design of GUI and segmentation will be done in Free Surfer 6.0. Gaurav Vivek Bhalerao et al [3] says that K-means clustering technique for segmenting the cc (corpus callosum) from MR image more the neurodevelopmental disorders affects directly or indirectly on the dialectal content of Corpus Callosum. K-means clustering algorithm helps in proposed for segmentation. Communication disorder and some learning disability. The output of K means clustering gives four distant clusters level of classifying distant regions in the MR image. Segmentation of corpus callosum from MRI is a challenging job. Neuro developmental disorders are Alzheimer's syndrome, Dyslexia, NPH. K means segmentation gives the output to identify the CC and shows that part of that disorder and it helps in shows predict the disorders stages. Ayman El-Baz et al [4] shows the analysis ground truth to identify the classification exact for each patient was given by clinical associates/doctors. Autism is one of a neurodevelopmental disorder. As Per the Centers for Disease Control (CDC) and Prevents almost 1 in 110 American children sick the autistic disorder. Markov-Gibbs random field methods are using, that alternative to the MRF modeling. Studying related to CC is one of the improvements in medical neurological disorder. CC causes the memory inpatient. Collection of data from patients only is called ground truth analysis. In this paper, they alternatively used the MRF algorithm for the segmentation to get the exact output. D. Judehemanth et al [5] says that Effective Fuzzy Clustering Algorithm for Abnormal MR Brain Image Segmentation as Fuzzy clustering algorithm using IFCM algorithm proved to be powerful over the remaining clustering approaches in the job of segmentation efficiency.

**Revised Version Manuscript Received on 22 February, 2019**

**B.J. Bipin Nair**, Department of Computer Science, Amrita School of Arts and Sciences, Mysuru. Amrita Vishwa Vidyapeetham, India.  
(e-mail: bipin.bj.nair@gmail.com)

**T.R. Pruthvi**, Department of Computer Science, Amrita School of Arts and Sciences, Mysuru. Amrita Vishwa Vidyapeetham, India.  
(e-mail: pruthvitgr@gmail.com)

Comparing and analysis in work of segmentation efficiency and convergence rate are working between FCM and IFCM.

Nosratallah Forghania et al [6] says that in this novel brain MR image Segmentation of Brain Tissue Using IFCM Algorithm with the help of one of Particle Swarm Optimization Segmenting technique of MR image is activates with fuzzy c-mean EM (Expectation Maximization). Brain tissue classification in brain MRI image is one of the major things to study neuro developmental diseases are Alzheimer and vascular dementia. These all are one of the neurodevelopmental disorders. In this paper, They used the FCM algorithm and integrated with the help of FCM they introduced the IFCM. IFCM means Improved FCM clustering. The output of this journal is that new optimization technique used on basis of PSO. Paul A. Yushkevich et al [7] says that ITK-SNAP is one of the free available software is significantly improved efficiency and reliability as open source application, used to make one set segmentation normally useable to huge stage scholars and researchers, adopt that with small or without mathematical expertise a developed standard image processing pipeline (line per line image will be analyzed and process the MRI image), including tissue class segmentation using EMS.

In this paper, they used active contouring filter technique for the preprocessing.

They used one of the integrated software ITK-SNAP (open source) for the image segmentation and it is an efficient and non-technical person can easily use this software and find out the problem. One of the easiest segmenting tool available.

Shan Shen et al says that [8] they improve Fuzzy CMeans to improved fuzzy c-means with neural network optimization. SD and MEAN each of the top level images and having the same histogram but also original images intensity will remain the same.

Here again common segmentation algorithm FCM clustering used here with some filtering technique to preprocess the image histogram equalization and median filters are used in this paper. Mohamed N. Ahmed et al [9] says that bias corrected-FCM is helpful for segmenting the brain MR image. Remove salt and pepper noise using median filters.

FCM c algorithm for adaptive segmentation and it helps in correction of intensity in brain MRI. Y. Zhang et al [10] say that EM-HMRF used segmentation algorithm and it as The Finite Mixture model to work only on high resolution and quality MR image with less noise and HMRF algorithm used here. Expect Maximization algorithm help to combine with HMRF and produce HMRF-EM framework, is an exact and effective segmentation can be done in this framework.

The HMRF-EM framework can normally be added with some other techniques. Bipinnairb.j et al [11] considered melatonin and fluoxetine interaction with shank3 protein gene associated with autism spectrum disorder.

They had constructed a new drug 2D structure and summarized that a two-dimensional (2d) structure of a drug is an essential factor for identifying the autism. N. Shoba Rani et al [12] have done a novel study on Telugu handwritten characters recognition.

For their research work they had taken the advantage of the zone based classification approach which is helpful for our work.

### III. PROPOSED WORK

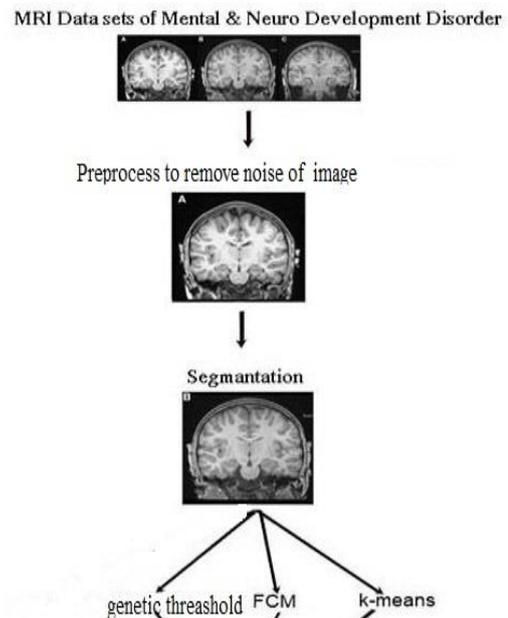


Figure 1: Flow diagram

First, we have collect datasets from hospitals or by from patient are called "ground analysis diagnostic". Collected MR images are 2 Dimensional (2D) of Autism, FASD (fetal alcohol syndrome disorder) and neurodevelopmental disorder. After collecting the Datasets of image pre-process the image to reduce the noise using a median filtering technique and to equalize the image color intensity using histogram equalization technique.

Image segmentation takes place a major role in my work because every segmented information will show the efficiency of the used algorithm and helps in predicting the stages of the mental and neurodevelopmental disorder. Used for segmentation are FCM (Fuzzy C Means), K-means clustering algorithm, and genetic threshold segmentation.

#### Methodologies

In our proposed work we have taken brain MRI then using median filter and histogram equalization removed the noise and further proceed with segmentation algorithms to detect autism and dementia using k-means, FCM and GT

- ▶ Pre-processing
  1. Median filter: To reduce the noise in MRI
  2. Histogram equalization: To Equalize image intensity
- ▶ Image segmentation
  1. K-means clustering segmentation
  2. Genetic threshold segmentation
  3. FCM



#### IV. MATHEMATICAL MODEL

Limited set of dataset

$$P = \{x_1, x_2, \dots, x_N\}$$

K means clustering mathematical formula

min

$$ca_1 \cup ca_2 \cup ca_3 \dots ca_k = p \sum_{i=1}^k \sum_{x \in ca_i} 1 \left\| x - \frac{1}{|k_i|} \sum_{t_j \in k_j} t_j \right\|^2$$

K means algorithms steps procedure`

1. Make clusters into one group called  $k$  groups and  $k$  is fixed.
2. Select any clusters and find the centroid.
3. Fix the obj to the nearest cluster centroid, Euclidean distance formula helps in find the nearest node or cluster.
4. Identify the clusters centroid of all objects
  1. Repeat steps 2-4 until, in continuous rounds identical obj assigns to same clusters.

FCM segmentation mathematical model

$$j_m \sum_{i=1}^n \sum_{j=1}^c u_{ij}^m \|x_i - c_j\|^2, 1 \leq m < \infty$$

Pseudo code

1. Initialize  $p=[p_{ij}]$  matrix,  $p^{(0)}$
2. In  $N$ -step: find the centers vectors  $C^{(k)}=[c_j]$  with  $U^{(k)}$

$$c_j = \frac{\sum_{i=1}^n u_{ij}^m .x_i}{\sum_{i=1}^n u_{ij}^m}$$

Update  $p^{(k)}, p^{(k+1)}$

$$u_{ij} = \frac{1}{\sum_{k=1}^c \left( \frac{\|x_i - c_j\|}{\|x_i - c_k\|} \right)^2}$$

3. If  $\|p^{(k+1)} - p^{(k)}\| < \epsilon$  then STOP; otherwise return to step 2.

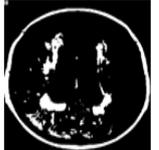
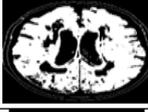
*Genetic threshold algorithm*

The GN algorithm of populace amount isn;begins with  $n^{\text{th}}$  random size. Finally it will select good size of member

Pseudo code

1.  $Im \downarrow$  Read image
2.  $Hist \downarrow$  image histogram ( $Im$ ) 0-
3.  $Pop \downarrow$  initial  $K$  chromosomes
4. For  $i = 1$  to number of iterations
5. While( $size(Pop) > size(NewPop)$ )
6.  $Ch1, Ch2 \downarrow$  Select two chromosomes by rolletwheel
7. If ( $rand < crossover$  rate) then
8.  $Chnew1, Chnew2 \downarrow$  crossover ( $Ch1, Ch2$ )
9. If ( $rand < mutation$  rate) then
10.  $Chnew1 \downarrow$  mutate ( $Chnew1$ )
11. If ( $rand < mutation$  rate) then
12.  $Chnew2 \downarrow$  mutate ( $Chnew2$ )
- If ( $fit(Chnew1) > \max(fit(Ch1), fit(CH2))$ ) then  $NewPop.Add(Chnew1)$
13. If ( $fit(Chnew2) > \max(fit(Ch1), fit(CH2))$ ) then  $NewPop.Add(Chnew2)$

**Table 1: Segmentation result**

| Segmentation      | Dementia  | Autism  |
|-------------------|---|---|
| K-Means           |  |  |
| FCM               |  |  |
| Genetic Threshold |  |  |

In our proposed work we are detecting mental and neurodevelopmental disorder from brain MRI, in our work we are detecting autism and dementia using K-means, FCM, and GT algorithm, out of these three algorithm k-means is the better algorithm which gives a better accurate result and other algorithms segmentation result is not accurate

#### V. CONCLUSION

In our proposed work, we collected around 100 data set of autism disorder and dementia disorder patients MRIs for analyzing these disorders. Then we proceed with preprocessing to locate the defected tissue, then extract the affected region using three segmentation algorithms, we will identify the mental and neuro developmental disorder. In future using various segmentation algorithm we can predict the stages Mental and neurodevelopmental disorder, it will give more efficient output.

#### REFERENCES

1. Karani, N., Chaitanya, K., Baumgartner, C., &Konukoglu, E. (2018). A Lifelong Learning Approach to Brain MR Segmentation Across Scanners and Protocols. *arXiv preprint arXiv:1805.10170*.
2. Iglesias, J. E., Augustinack, J. C., Nguyen, K., Player, C. M., Player, A., Wright, M., ...&Fischl, B. (2015). A segmentation of in vivo MRI. *Neuroimage, 115*, 117-137.
3. Bhalerao, G. V., &Sampathila, N. (2014, November). K-means clustering approach for segmentation of corpus callosum from brain magnetic resonance images. In *Circuits, Communication, Control, and Computing (I4C), 2014 International Conference on* (pp. 434-437). IEEE.
4. El-Baz, A., Elnakib, A., Casanova, M. F., Gimel'farb, G., Switala, A. E., Jordan, D., & Rainey, S. (2011). Accurate automated detection of autism-related corpus callosum abnormalities. *Journal of medical systems, 35*(5), 929-939.
5. Selvathi, D., &Anitha, J. (2009, March). Effective fuzzy clustering algorithm for abnormal MR brain image segmentation. In *Advance Computing Conference, 2009.IACC 2009. IEEE International* (pp. 609-614). IEEE.
6. Forghani, N., Forouzanfar, M., &Forouzanfar, E. (2007, November). MRI fuzzy segmentation of brain tissue using IFCM algorithm with particle swarm optimization.

7. In *Computer and information sciences, 2007.iscis 2007. 22nd international symposium on* (pp. 1-4).IEEE.
8. Yushkevich, P. A., Piven, J., Hazlett, H. C., Smith, R. G., Ho, S., Gee, J. C., &Gerig, G. (2006). User-guided 3D active contour segmentation of anatomical structures: significantly improved efficiency and reliability. *Neuroimage*, 31(3), 1116-1128.
9. Shen, S., Sandham, W., Granat, M., &Sterr, A. (2005). MRI fuzzy segmentation of brain tissue using neighborhood attraction with neural-network optimization. *IEEE transactions on information technology in biomedicine*, 9(3), 459-467.
10. Ahmed, M. N., Yamany, S. M., Mohamed, N., Farag, A. A., & Moriarty, T. (2002). A modified fuzzy c-means algorithm for bias field estimation and segmentation of MRI data. *IEEE transactions on medical imaging*, 21(3), 193-199.
11. Zhang, Y., Brady, M., & Smith, S. (2001). Segmentation of brain MR images through a hidden Markov random field model and the expectation-maximization algorithm. *IEEE transactions on medical imaging*, 20(1), 45-57.
12. Bipinnairb.j., Arunjit k., &VijeshBhaskaran(2017). Melatonin and fluoxetine interaction with shank3 protein gene for autism spectrum disorder. *Pakistan journal of Biotechnology*.
13. Rani, N. S., Verma, S. K., & Joseph, A. (2016). A Zone Based Approach for Classification and Recognition Of Telugu Handwritten Characters. *International Journal of Electrical and Computer Engineering (IJECE)*, 6(4), 1647-1653.

