Modified Image Segmentation Schemes for Detection & Identification of MRI Brain Tumor Infection

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Abstract: Nowadays an advancement in the medical field has an additional contribution to the human health care system. Many of the time, it cannot be possible to predict MRI brain tumor with naked eyes and unable to identify the disease stage. The patient may lost their live due un accurate and delayed diagnosis. Only CT scan and MRI cannot identify the disease, required supporting soft computing tools (PSO -particle swarm optimization) to diagnose with high accuracy. To perform accurate detection and analysis of the infected tumor, need some additional technical effort. The proposed concept suggests an algorithm using soft computing to identify infected regions of brain tumor along with its comparison with other existing image segmentation method. Result analysis shows that the result obtained with the proposed method are superior to existing segmentation techniques.

Keywords: MRI Image, CT Scan, Image Segmentation, K Means Clustering, C-Fuzzy Means, Artificial Neural Network

1. Introduction

Human health is precise to each and every human living on this earth. Most of the countries spend millions of dollars on people health [01]. In India, the government has more than 10% expenditure of GDP on public health and on the health sector. Recently Government of Indiahas started "AyushmanYojana" [02] that provide free medical service to every citizen of India who is below the poverty level. Not only in India but in other regions of the world's also government very careful abouttheir citizen health. Recent days, it is observed that the number of peoples died throughout the world due to incorrect medical treatment. Most of the doctors even though they have a good practice fails to predict the gravity of the disease.Prediction of disease at the earliest stage and also to predict its coming Gravity is very important to remove any disease from society. In America itself even though called a well- developed country, many people die because of wrong medical treatment. Technology must be introduced in the medical sector to predict and to measure the gravity of disease so that disease should becovered at the earliest stage [03]. Health Scheme started by the government of India is called as one of the biggest social schemes throughout the world.

Because of lack of money, many people in the world do not prefer to visit the doctor. "Adivasi" people mostly believe in black magic and they try to cure any disease in a natural way. In this digital era, the technique is so advanced and improved that changed human life. This technique should be introduced in the Health-care sector to predict and to measure the gravity of any kinds of disease.

This paper proposes a concept that helps to find out the tumor in MRI brain image with the help of image processing technique. With normal practitioner, it is quite difficult to locate, identify and to measure Gravity of tumor from the image. MRI scan is a famous brain Scanning System where the inside picture of brain is captured by Magnetic resonance machine.

Brain tumor is the abnormal growth of cells inside the brain. Brain Tumor is classified as Benign and malignant tumor. Generally, brain cells grow in normal and control way. An early-stage tumor is called a benign tumor whereas later stage tumor is called a malignant tumor. The gravity of any tumor measured with its infection level. If a tumor is at the primary stage, it is easy to recover from it. There are almost 120 types of brain tumors exist throughout the world out of which most of the tumor is cured at the earliest stage.

Magnetic resonance imaging (MRI) [04] provides information about brain tumor anatomy, converting it into an important tool for effective diagnosis, treatment, and monitoring of tumor diseases. Detecting tumor region from MRI image is one of the most challenging tasks in today's modern era. Segmentation which is the most challenging tasks of computer- based clinical Diagnostic tools. A large variety of algorithms for segmentation are available that helps to segment an image accurately and more precisely.

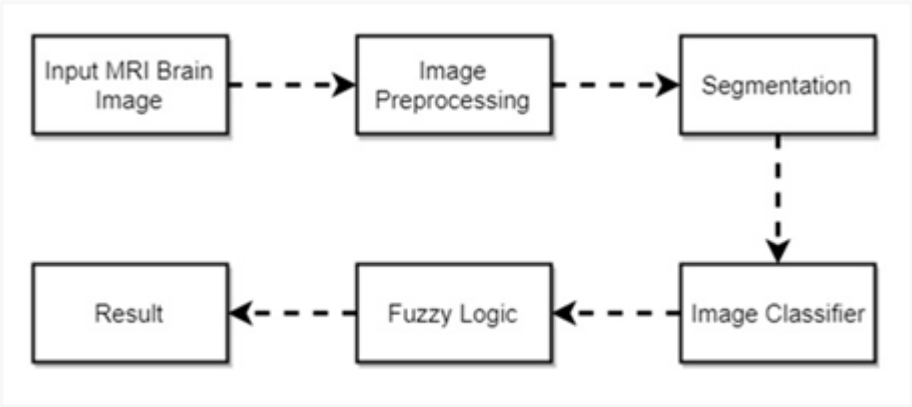

Figure. 1. Architecture diagram of tumor detection using imageprocessing

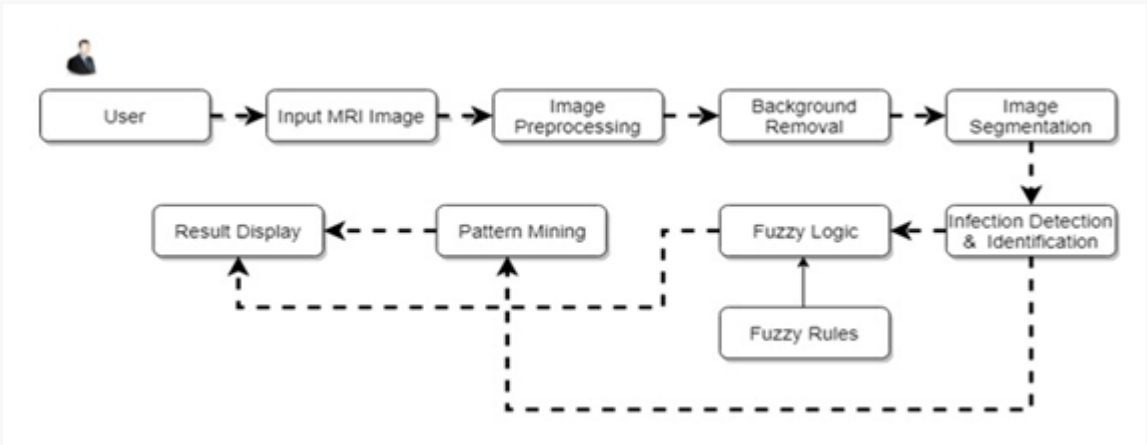

Figure. 2. Data flow diagram

Figure 1 shows an architecture diagram of tumor detection using MRI scan image. Before to proceed for tumor detection, an image preprocessing is done to get the optimize output. Image pre-processing may be re- sizing, enhancing an image. And after image preprocessing, an image segmented into multiple regions based on color or shape. In the proposed system, image segmentation done through proposed clustering and its comparison is shown with other existing techniques like fuzzy c-means clustering, Particle Swarm Optimization (PSO) segmentation, K-means segmentation, etc. Segmentation is an important part of the proposed concept because it helps to identify and infected region from MRI image.

Image classifier helps to divide/classify an image into to region of interest (ROI) and non-region of interest areas. Region of interest is an area where the developer has an actual interest to locate brain tumor. Once the Region of Interest (ROI) identified, it's very easy to locate infected region from MRI scan image. Many of techniques puts image classifier under image preprocessing section. An infected region identified in ROI is given as input to fuzzy logic where different Fuzzy Logic rules are applied so as to measure its Gravity. Fuzzy logic is a conditional statement where the decision is given as an intermediate. For example, to measure a brightness level of Shadow, Fuzzy rules are better because your shadow, the answer is an Intermediate result about light intensity.

2. Praposed Methodology

Propose concept can be elaborated with a data flow diagram, architecture diagram, an algorithm, etc. Propose concept is divided into multiple models like image preprocessing background removal, image registration, fuzzy Logic analysis, etc. Below diagram shows a data flow diagram for the proposed system. From the data flow diagram, the proposed system is divided into seven phases that are image preprocessing, background removal, image segmentation, infected region detection and identification, fuzzy logic and pattern mining.

Image Preprocessing

Image preprocessing is a term used to identify an operation on an image before to input it to an algorithm.In the proposed system, image preprocessing involves enhancement of image and smoothing of image. Image

enhancement can be done by upgrading pixels of an image from black to white and vice versa. To do image enhancement, mean intensity of an image is considered.

$$Mean\ Intensity\ (MI) = \frac{(\sum_{i=1}^{n}\sum_{j=1}^{m}(P_{i,j}))}{n * m}$$

Helps to decide which pixels should be white to black and black to White. Example pixels which are closer to decimal value 255 are reducedwiththeirintensityvalueandpixelswhicharecloser to zero are updated towards white. Enhancement factor efforimageenhancementcanbedecidedbyobservationsand previousexperience.

Algorithm

1 Start
2 Input an Image I
3 Calculate Mean Intensity (MI) of an Image
4 *if* $MI \geq 0$ &MI^{TM} 0.3
$Ef = 0.3$

End

If $MI \geq 0.4$ &$MI^{TM}0.6$

$Ef = 0.6$

End If MI ≥ 0.7 &$MI^{TM}0.9$

$Ef = 0.8$

End If $MI > 0.9$

$Ef = 1$

End

5 *Enhance an Image* $I = I * Ef +$

An input image can be enhanced with

$$f(x) = J_{i=1}^{n}J_{j=1}^{m}\left(\left(P_{i,j}\right) * Ef + \left(P_{i,j}\right)\right)$$

Imageenhancementisveryimportantasitremovesnecessary noise from an image and helps to accurately detect and predict tumor in brainimage.

BackgroundRemoval

Every image has some background which should be re- moved to get an accurate result. Background removal is a process where unnecessary background image pixels are not considered as a part of processing. Let's consider an image shown below.

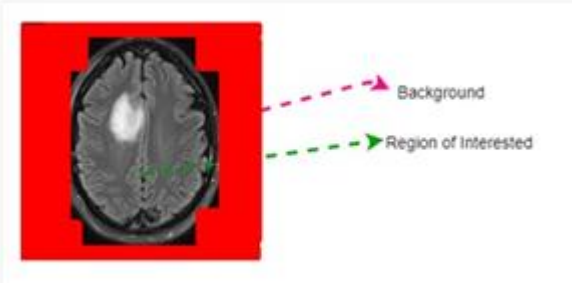

Figure3. Background removal

Background image pixels are identified based on their intensity values. In the proposed system, pixels values which are closer to intensity value 0 are considered as black pixels/background pixels. Many of the time, only pixels closer to intensity value 0 not considered as a background pixel. In this, group of consecutive pixels identified whose values are closer to intensity value 0. These group of consecutiveblack pixels are considered as background pixels and mark with separateredcolorf(255,0,0).Backgroundremovalprocess divides an image into a region of interest(ROI) and non- region ofinterest.

$$Class_{Non_{roi}} = (P_{ij} \geq 0)\&(P_{ij} \leq 50)$$

$$Class_{roi} = (P_{ij} \geq 51)$$

Algorithm

1 Start
2 Input an Enhance Image(I')
3 $for\ i = 0\ to\ W(I) * H(I)$
$Read\ Pixel\ P_i$
$Extract\ RGB$
$If\ P_i \geq 0\ \&P_i{}^{TM}50$
$counter = counter + 1$
$Else$
$Counter = 0$
End
$If\ Counter = 10$
$Convert\ pixels\ P_i\ to\ (P(i + 10)\ to\ (255,0,0)$
End
4 $Save\ background\ removed\ image(I$
5 $Stop$

As shown in figure 3, background pixels are separately marked with red color. The developer always has the interest to find out tumor region in non-red pixels of MRI brain. These red pixels are not considered for the processing which may save time and increase an accuracy of the result.

Image Segmentation

Image segmentation is a step where images divided into multiple regions according to its color. In propose concert, we are created multiple classes which are identified with multiple colors. To understand the process of image segmentation, let's consider any image represented in a matrix format.

Initially, the current pixel at position 0, 0 is kept in class1. Second pixel at position 0, 1 is compared with pixel 1. If ⟦|p1-p2|⟧^TM 10means pixel p2 is closer to pixel p1 and hence added to class 1. Similarly, image pixel p3 is compared with pixels in class 1 and class 2, if similarity occurs with anyone of class then it will be added in that class else new class will be created and pixel p3 will be added into a new class.

Table.01 Image matrix

An image segmentation will help to identify an infected region from MRI brain image. From an analysis, it is found that an infected pixels belong to either extreme white cate- gory or extreme black category pixels. Image segmentation will separate these pixels and helps to identify infected pixels very easily. There are too many image segmentation techniques are available like k-means clustering, genetic algorithm, C-fuzzy means, neural network base clustering, color based clustering etc. With our proposed method we are focusing on creating clusters of an image based on its intensity value or itscolor.

D. Infection Detection andIdentification

Once affected regions from MRI brain image gets identified, it is registered with respect to input MRI brain image. Registration process done with the proposed method iscalled a position to position registration. This helps to identify an infected region with respect to an input image. Below algorithm helps to identify and infected fixes from animage.

ImageRegistration Algorithm

Start

1 *Read input iamge I and Segmented Im*
2 *Set threshold*
3 *for* $i = 1$ *to width* (I)
for $j = 1$ *to height* (I)

if S_i threshold

$S_i\ (i,j) \leftarrow (255,0,0)$

End

End

End Save Registared Image Ri

4 *Stop*

In figure 4, only mapping of a few pixels is shown. However, with proposed image registration techniques, an entire image is registered with an original input image. The mapping function f(x) siMap only those pixels which are greater than or equal to threshold value specified in the image registration algorithm

E. Pattern Mining

A process of finding search patterns in a registered input image is called as pattern mining. Propose algorithm concentrate on template matching algorithm that finds different infected patterns stored in a database into a registered MRI brain image. Meta-data is created for each and every image pattern in the database. This meta-data helps to represent knowledge about pattern according to a registered MRI image. The process of template matching work on a binary pattern of an image. Both the images i.e registeredMRI image and database image are converted into binary format andthenpointtopointmappingisperformed. Resultsofpatternmatchingaremeasuredwiththeparameters like mining time, accuracy, precision, acceptance ratio, etc. These are the standard parameters to major performance of any miningtechniques

Template Matching Algorithm

1. *Start*
2. *Read Database Image(D)*
3. *Read Registered Image (R_i)*
4. *for i = 0 to length (D)*
   if D_i found (R_i)
   Calculate %
   Add to cart
   End
   End
5. *Sort percentage with desending order list(L)*
6. *Extract meta data with L(0)*
7. *Stop*

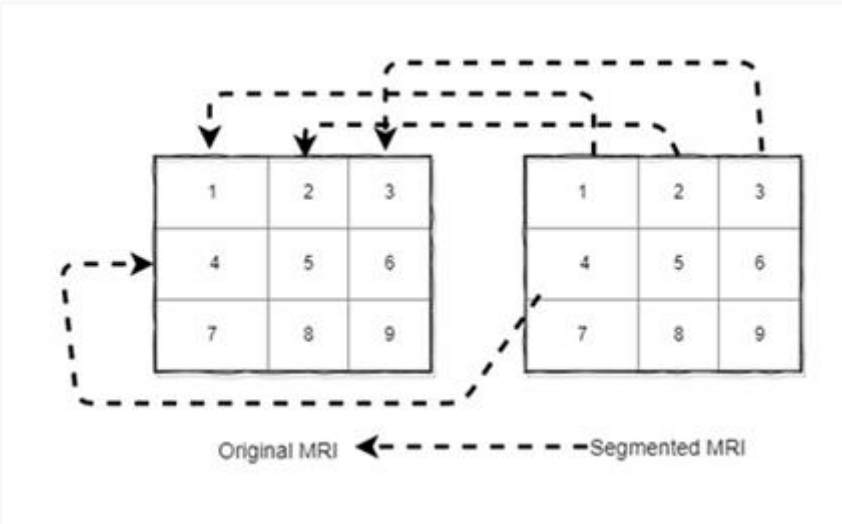

Figure. 04 Image registration

3. Results Analysis

Result analysis is a measure of proposed system parameters and its comparison with existing techniques. Resultanalysis helps to measure concept acceptability, applicability and itsimplicationsoverothermethods.Asshowninfigure5.a represent original input image, 5.b for background removedimage, 5.c infected region with the proposed method, 5.d infected region with Particle Swarm Optimization (PSO) method, 5.e infected region with K-means clustering and 5.f infected region with C-fuzzy means clustering. From image 5.b, one can conclude that the background removal process is so accurate with propose algorithm that region of interest gets extracted smoothly and accurately. Image 5.c concludes that with the proposed method "true positive" parameter is high because it exactly locates the infected region where it actually present. Image 5.d (PSO) also have accuracy approximately closer with the proposed method. K-means clustering is not best suited for image segmentation. Most of the time, image not get properly segmented and hence not provide accurate results over others. C-fuzzy means clustering has a high "false negative" ratio and definitely not a good choice in Medical ImageProcessing.

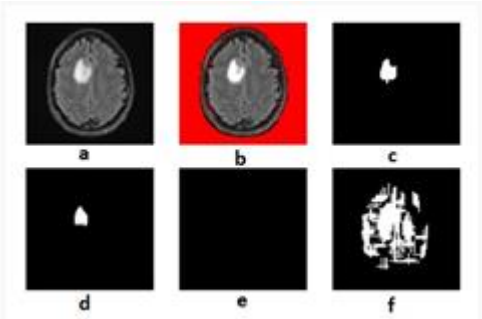

Figure. 5. (a,b,c,d,e& f) Comparative results of proposed system

From table.2, one can conclude that the number of infected fixes identified is accurate and with the minimum time span. Results obtained by PSO and C-fuzzy means clustering is not good enough accept for MRI brain tumor detection.

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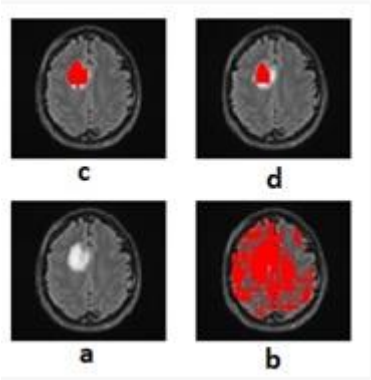

Figure. 6 (a,b,c& d) Propose method

Figure 6 shows a total of 4 images (a, b,c& d) which are registered images with propose method, PSO, k means clustering and C-fuzzy means clustering techniques respectively. From figure 6 we can conclude that the amount of accuracy received by the proposed method in all aspects is higher than other segmentation methods. Even though PSO have a good accuracy but still it does not reach at a level of propose image segmentation. Accuracy of a segmentation methodcan be tested by registering an infected region in an inputimage.

Table2: Comparison of propose technique with other image segmentation techniques

Method	Infection	% Infection	InfectionLevel	ROI	Non ROI	Time (Sec)
Proposed	173	3.46	Normal	5000	5000	0.19
PSO	118	2.36	Normal	5000	5000	9.52
KMeans	0	0	Normal	5000	5000	0.36
Fuzzy-C-Means	1562	31.24	Average	5000	5000	1.03

4. Conclusion

From result analysis, propose the technique of infection detection and its level measurement is superior over other existing image segmentation techniques. Results are more precise, accurate and acceptable with human eyes. Performance of the proposed system is measured with an image registration process shown in figure 6 implied that the proposed system is accurate and hence in future may be a good choice by Medical Application developers. Background removal is accurately achieved (approximately 90%) that helps to concentrate on the on ROI region of image.

5. Future Scope

Even though with propose method, results obtained are better than other image segmentation method, but still results are affected by the image quality. One should concentrate image with all types of quality, noise, visibility, etc. The pro- posed technique should require to set an adaptive threshold according to the quality of an image. Background detection and removal is a challenging task which should require more precision. Many of the time, a region of interest pixels is considered as background pixels which may affect entire results of the proposed system.

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Conflict of Interest:

The authors confirm that there is no conflict of interest to declare for this publication.

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