NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 3, ISSUE5, MAY-2016

COMPUTER AIDED DIAGNOSTIC SYSTEM FOR BRAIN TUMOR DETECTION USING K-MEANS CLUSTERING

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ABSTRACT

Medical informatics researchers have started believing, that the ultimate aim of "computer aided diagnosis" (CAD) and it should be advances as time is progressing and it must assist to make clinical decision support. The concept called image processing is at very attractive technique for advancement of human perception. Large interest in image processing methods stems from two principal applications: improvement of pictorial information for interpretation of human and processing of image data for storage, transmission and representation for autonomous algorithms. This method can be applied for analysis of images in a large number of domains. In modern world influence of and impact of digital images is very high, and now a days image processing has become critical technology is today's world. CAD systems are very much useful for facilitating lesion detection and characterization of images, and it is accomplish by enhancing the medical practitioners capabilities and considerable reduction in time, accurate diagnosis and treatment is also made fast and possible.

KEYWORDS: Computer Aided Diagnosis, K-means clustering algorithm, brain tumor, Median filer, Localized Region Based Active Contour Segmentation etc.

INTRODUCTION

Living creatures in entire world are made up of cells. The adult body normally forms new cells only when they are needed to replace old or damaged ones. Infants and children create new cells to complete their development in addition to those needed for repair. A tumor develops if normal or abnormal cells multiply when they are not needed. A brain tumor is a mass of unnecessary cells growing in the brain or central spine canal. There are two basic kinds of brain tumors – primary brain tumors and metastatic brain tumors. Primary brain tumors start and tend to stay, in the brain. Metastatic brain tumors begin as cancer elsewhere in the body and spread to the brain. When doctors describe brain tumors, they often use the words "benign" or "malignant." Those descriptions refer to the degree of malignancy or aggressiveness of a brain tumor. It is not always easy to classify a brain tumor as "benign" or "malignant" as many factors other than pathological

features contribute to the outcome. Sometimes a brain tumor is found by accident – it may be seen on a scan performed for a non-brain tumor purpose – but most commonly, a tumor makes its presence known by interfering with the normal workings of the body. Follow-up care for a brain tumor extends over a lifetime, not unlike many other medical conditions. At some point, depending on the type of tumor, your brain tumor may become a "chronic illness" just as heart disease or diabetes is "chronic" conditions. Understanding of all tests is important for making accurate diagnosis. Different stages are involved in correct diagnosis procedure.
The doctor begins the diagnosis by taking medical history of patient and asking him to describe his symptoms, including how long he has had them, when they occur, the order of their appearance, if they seem to be brought on by something in particular and if they seem to be getting worse. Then the doctor will perform a basic neurological examination in the office. If the results of neurological examination lead the doctor to suspect the patient to have a brain tumor, a scan will be ordered or he might be referred to a neurological specialist for additional testing including scans, X-rays or laboratory tests. Imaging takes the place of conventional X-rays, which do not show tumors located behind and follow-up are Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI). Both CTs and MRIs use computer graphics to create an image of the brain. During a scan, an injection of a special contrast material (dye) is given to make abnormal tissue more obvious. Contrast materials are able to highlight abnormalities such as tumors because the dye concentrates in diseased tissues due to the leakiness of blood vessels in and around brain tumors.

PROBLEM DEFINITION

The objective of this work is to implement a Brain Tumor Detection system using improved method of segmentation based on soft computing. Segmentation of brain MRI image is crucial step of this work. To implement this, different approaches such as manual, semi-automatic & automatic segmentation will be used. Then results of different segmentation methods will be compared with each other. The obtained segmentation features will be used to detect tumor stage. The results of classification of tumor stage will be compared with standard results to evaluate the performance.

PROBLEM SOLVING STRATEGY

The MRI image segmentation is obtained by different approaches:

1. Manual ROI (Region of Interest) selection segmentation.
2. Semi-automatic ROI (Region of Interest) selection segmentation.
3. Automatic ROI (Region of Interest) selection segmentation.

The strategy to solve the problem changes with different approach. These approaches can be explained as below.

MANUAL ROI SELECTION SEGMENTATION:

Figure 1 shows the block diagram of CAD system with manual ROI selection approach.

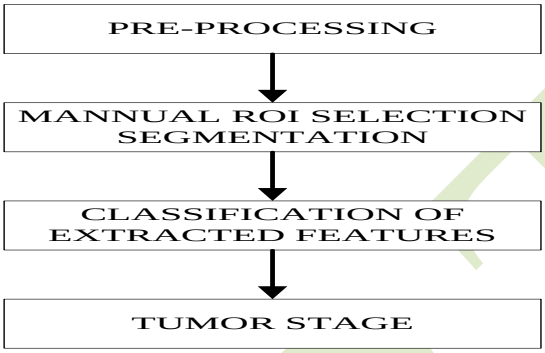

Fig. 1 Block Diagram of Manual ROI selection segmentation method

For manual ROI selection segmentation following steps is involved:

1) ROI selection using computer mouse. Using the mouse the physician can select the particular region which he seems to be tumor area.
2) To give the ROI he has to press left click of mouse & move the mouse around the suspicious tumor region. For this method the localised segmentation recognition technique is implemented. As per the selected ROI the localised segmentation recognition technique perform given no. of iterations & finally gives tumor features separated from original MRI image.
3) After segmentation the extracted features are used to calculate tumor area. This tumor area is useful to decide tumor stage which is implemented in classification step.

SEMI-AUTOMATIC ROI SELECTION SEGMENTATION: Figure 2 shows the block diagram of CAD system with semi-automatic ROI selection approach.

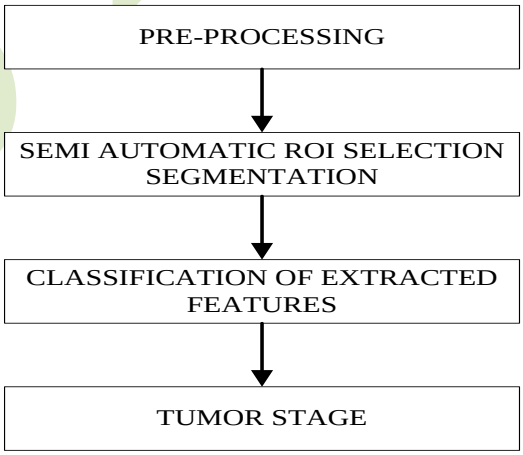

Fig. 2 Block Diagram of Semi-automatic ROI selection segmentation method

For semi-automatic ROI selection segmentation following steps is involved:

1) ROI selection using computer mouse. Using the mouse the physician can select the particular region which he seems to be tumor area.
2) To give the ROI he has to give a single point as initial seed. For this method the seeded region growing technique is implemented. As per the given seed the seeded region growing technique perform the segmentation & finally gives tumor features separated from original MRI image
3) After segmentation the extracted features are used to calculate tumor area. This tumor area is useful to decide tumor stage which is implemented in classification step.

AUTOMATIC ROI SELECTION SEGMENTATION: Figure 3 shows the block diagram of CAD system with automatic ROI selection approach.

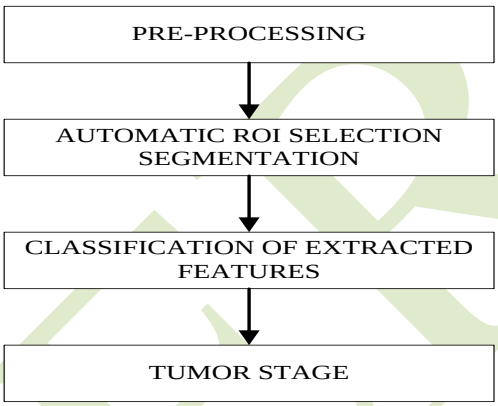

Fig. 3 Block Diagram of Automatic ROI selection segmentation method

RESULTS AND DISCUSSIONS

RESULTS & PERFORMANCE ANALYSIS OF MEDIAN FILTER:

To apply filters some test images obtained from public sources have been tested. Figure 3 shows noisy image with salt & pepper noise. To remove noise the median filter is used. The filtered image after removal of noise is shown in Figure 4. The entropy of noisy image with salt & pepper noise before application of median filter was 5.0820 which got reduced to 5.0070 after application of median filter.

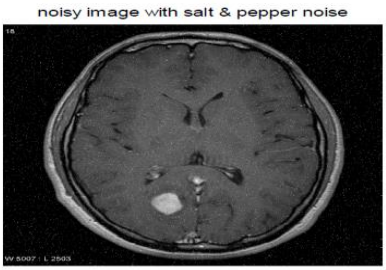

Fig 3 Noisy image with salt & pepper noise

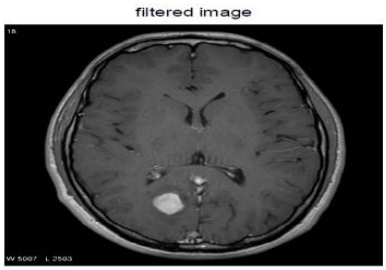

Fig. 4 Filtered image using Median filter

Figure 4.3 shows noisy image with poison noise. To remove noise the median filter is used. The filtered image after removal of noise is shown in Figure 6. The entropy of noisy image with poison noise before application of median filter was 5.7533 which got reduced to 5.3898 after application of median filter.

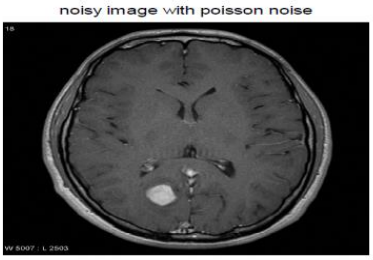

Fig .5 Noisy image with poison noise

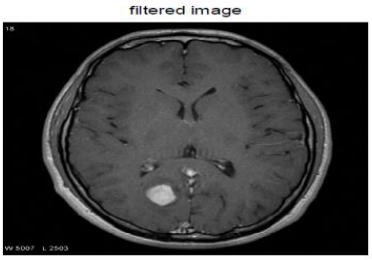

Fig .6 Filtered image using Median filter

4.6.2 Image standardization performance analysis using Histogram Equalization:

Figure 7 shows original MRI image. The histogram of original MRI Image is as shown in Figure 8 As per histogram representation most of the greyscale pixels are in between 50 to 100

Fig .7 Original MRI Image

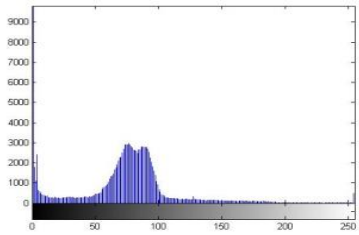

Fig .8 Histogram of Original MRI image

Figure 7 shows Histogram equalised MRI image. The histogram of histogram equalised image considered as modified image is shown in Figure 8. By comparing Figure 6 & Figure 8, the histogram of modified MRI image is more flat than histogram of original MRI image.

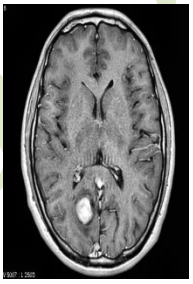

Fig .9 Histogram equalized MRI Image

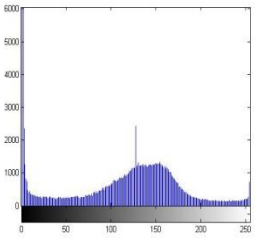

Fig .10 Histogram of modified MRI image

4.6.3 RESULTS OF LOCALIZED REGION BASED ACTIVE CONTOUR SEGMENTATION:

To verify the performance of system in this project we have considered 10 different images named as BT 1, BT 2, ..., BT 10. For manual ROI selection approach using Localized Region Based Active Contour Segmentation all test images are considered. The results for each image are as given below, where 1st window of each figure shows original image with selected ROI using manual approach. To give the ROI we have to press left click & trace out the suspected part of image as ROI. After definition of ROI the binary mask will get formed, as shown in 2nd window. This binary mask is used for segmentation process with given no. of iterations; this iterative process is shown in 3rd window. The final segmentation of tumor from all other part is shown in 4th window. The results for all test images are:

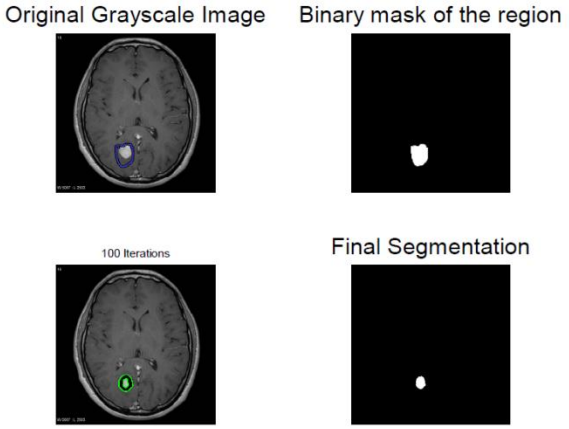

Fig 11. Result of image BT 1

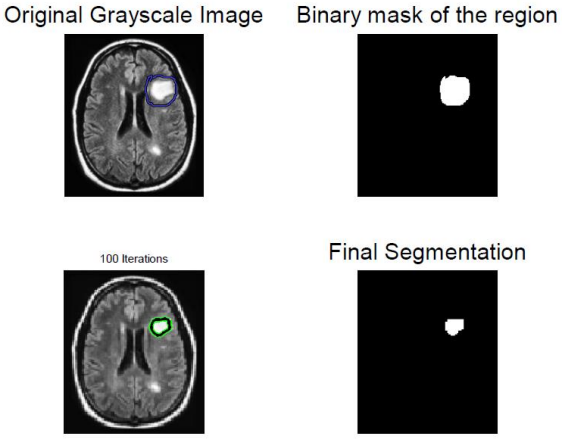

Fig 12 Result of image BT 2

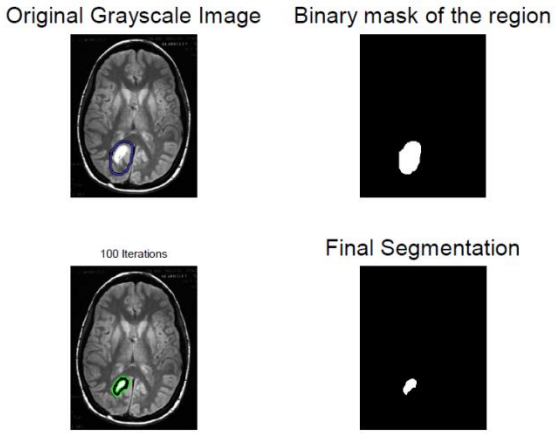

Fig 13 Result of image BT 3

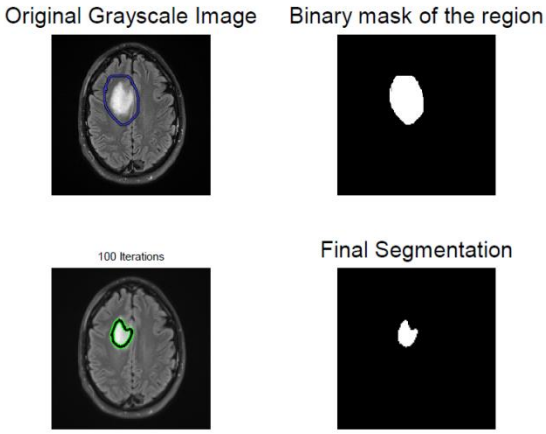

Fig 14 Result of image BT 4

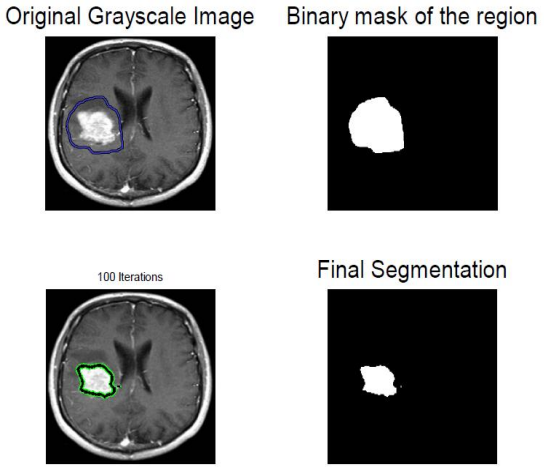

Fig 15 Result of image BT 5

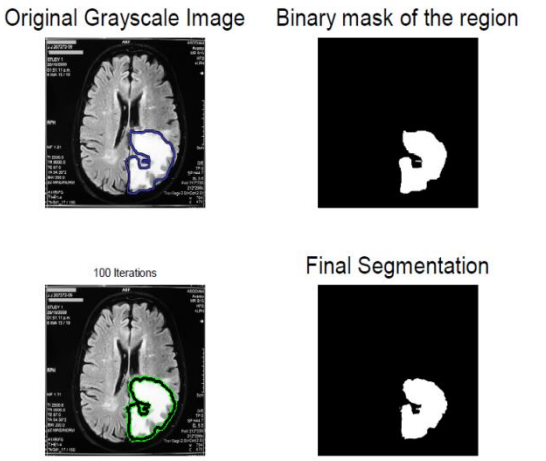

Fig 16 Result of image BT 6

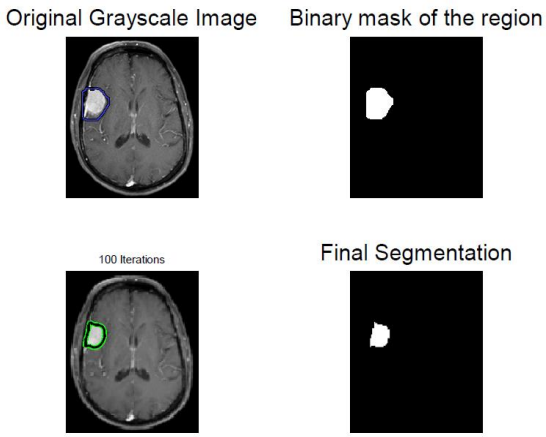

Fig 17 Result of image BT 7

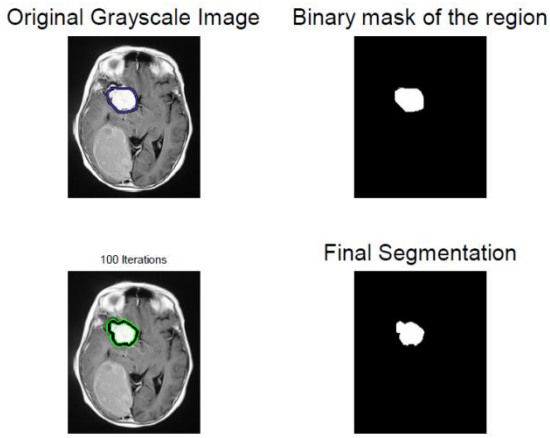

Fig 18 Result of image BT 8

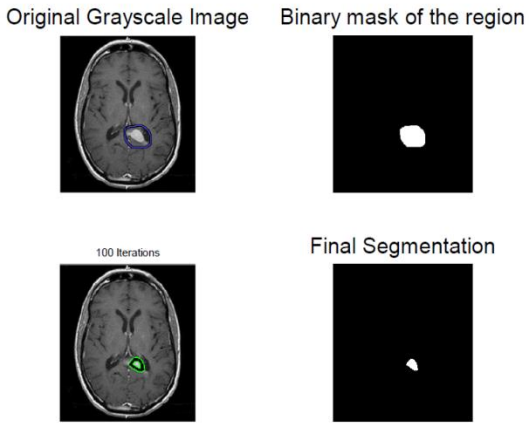

Fig 19 Result of image BT 9

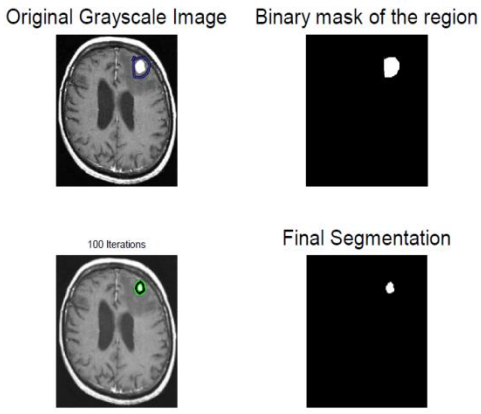

Fig 20 Result of image BT 10

Table 1 shows BWAREA (black & white area) of skull & tumor for each image using manual ROI selection approach.

Table 1 Result of BWAREA of skull & tumor

IMAGE	BWAREA OF SKULL	BWAREA OF TUMOR
BT 1	5.1291e+05	812
BT 2	2.3052e+04	91
BT 3	1.2903e+05	301.25
BT 4	31162	225.75
BT 5	1.1217e+05	1065.3
BT 6	3.3285e+05	58937
BT 7	3.0035e+04	184.7500
BT 8	8.0615e+04	820.2500
BT 9	1.3461e+05	212.7500
BT 10	5.6294e+04	74.2500

RESULTS OF SEEDED REGION GROWING SEGMENTATION:

To verify the performance of system it should be applied on different images. For this, in this project we have considered 10 different images named as BT 1, BT 2, ..., BT 10. Each image is separately checked & analysed for effective validation. For semi-automatic ROI selection approach using Seeded Region Growing Segmentation all test images are considered. The results for each image are as given below, where 1st window of each figure shows original image. The final segmentation of tumor from all other part is shown in 2nd window. This segmented tumor part is used to calculate tumor area which is very important aspect of tumor stage classification. The results for all test images are as given below.

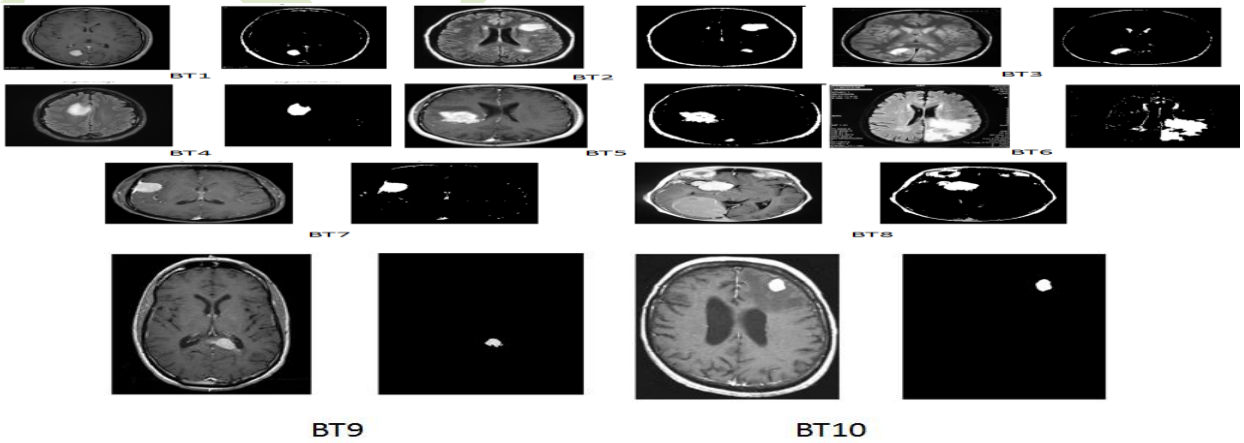

Table 21 shows BWAREA (black & white area) of skull & tumor for each image using semi-automatic ROI selection approach.

Table 2 Result of BWAREA of skull & tumor

IMAGE	BWAREA OF SKULL	BWAREA OF TUMOR
BT 1	5.1291e+05	2705
BT 2	2.3052e+04	379.1250
BT 3	1.2903e+05	1092
BT 4	31162	994.3750
BT 5	1.1217e+05	3396.6
BT 6	3.3285e+05	1.4154e+05
BT 7	3.0035e+04	600.2500
BT 8	8.0615e+04	2.8884e+03
BT 9	1.3461e+05	915.5000
BT 10	5.6294e+04	354.3750

5.2: RESULTS OF K-MEANS CLUSTERING:

K-means clustering is a method of cluster analysis which aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean. K-means is one of the simplest unsupervised learning algorithms that solve the well-known clustering problem. The purpose of k-means algorithm is to cluster the data. K-means algorithm is one of the simplest partitions clustering method. Clustering the image is grouping the pixels according to the some characteristics. In the k-means algorithm initially we have to define the number of clusters k. Then k-cluster center are chosen randomly. The distance between the each pixel to each cluster centers are calculated. The distance may be of simple Euclidean function. Single pixel is compared to all cluster centers using the distance formula. The pixel is moved to particular cluster which has shortest distance among all.

Steps:

I. Place K points into the space represented by the objects that are being clustered. These points represent initial group of cancroids.
II. Assign each object to the group.
III. When all objects have been assigned, recalculate the positions of the K cancroids.
IV. Repeat steps II and III until the centroids no longer move. This produces a separation *of the objects into groups.*

To verify the performance of system it should be applied on different images. For this, in this project we have considered 10 different images named as BT 1, BT 2, ..., BT 10. Each image is separately checked & analysed for effective validation. For automatic ROI selection approach using K-means Clustering Algorithm all test images are considered. The results for each image

are as given below, where 1st window of each figure shows original image. The final segmentation of tumor from all other part is shown in 2nd window. This segmented tumor part is used to calculate tumor area which is very important aspect of tumor stage classification. The results for all test images are as given below.

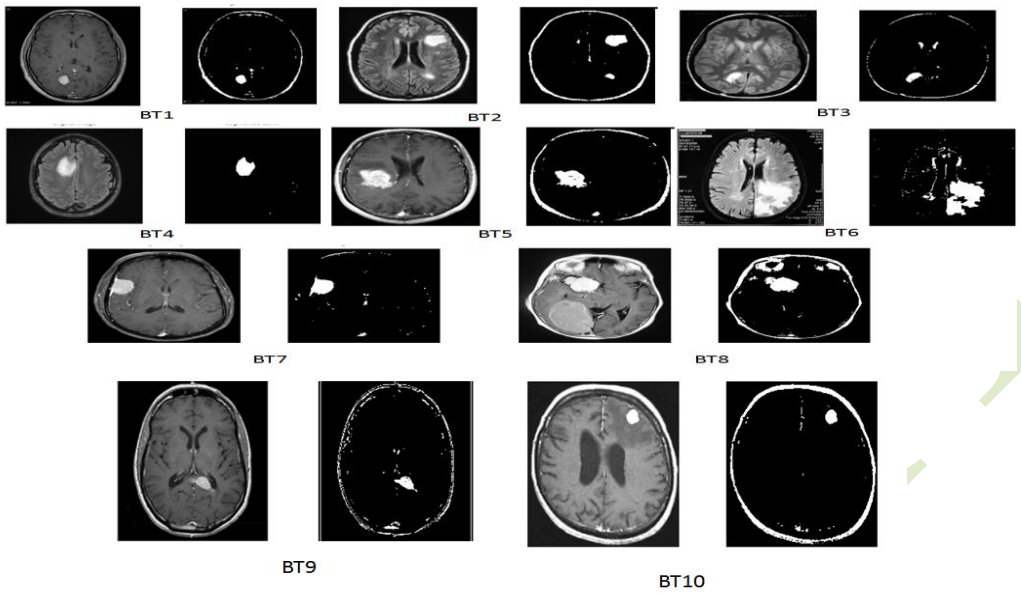

Fig. 22 Original and segmented tumor images

The skull area, tumor area & proportional area is calculated & collected in tabular form as shown in Table 5.1. Here for k-means clustering we have taken k=5 i.e. the input image is divided into 5 clusters. These clusters are converted to binary images to calculate tumor area.

Table 5.1 Result of BWAREA of skull & tumor

image	Skull area	bwarea	Prop area
BT 1	2.3822e+04	1.5865e+03	6.66e-02
BT 2	2.6980e+04	2.7046e+03	1.00e-01
BT 3	2.6974e+04	1.1515e+03	4.27e-02
BT 4	19022	756.2500	3.98e-02
BT 5	3.0301e+04	3.0465e+03	1.01e-01
BT 6	2.1753e+04	2.9271e+03	1.35e-01
BT 7	2.8259e+04	1.0678e+03	3.78e-02
BT 8	2.5339e+04	4.0788e+03	1.61e-01
BT 9	2.3932e+04	1.8961e+03	7.92e-02
BT 10	3.1649e+04	3.0701e+03	9.70e-02

CONCLUSION

We developed and tested a new CAD scheme for brain tumor detection & classification of tumor stage. To improve the system we tested & examined different MRI brain images. Different segmentation methods such as Localized Region Based Active Contour Segmentation, seeded region growing & K Means clustering are used. Testing of all segmentation methods carried out to compare performance of each method. By comparing performance analysis of all methods we can conclude that, K Means clustering along with ANN classifier gives most accurate results. The study showed that the tumor detection & classification can be done effectively with the presented method. By taking MRI images of a patient at regular interval we can also predict the growth rate of tumor which is very difficult to find without CAD system. The presented CAD system gives useful opinion to doctors for accurate detection of tumor & its stages.

REFERENCES

1. Kailash Sinha, G.R.Sinha, " *Efficient Segmentation Methods for Tumor Detection in MRI Images"2014 IEEE Student's Conference on Electrical, Electronics and Computer Science.978-1-4799-2526-1/14/©2014IEEE. pp.1-6.*

2. J.Vijay, J. Subhashini, " *An Efficient Brain Tumor Detection Methodology Using k mean clustering algorithm " International conference on Communication and Signal Processing, April 3-5,2013,India.978-1-4673-4866-9/13/©2013 IEEE.pp.653-657.*

3. K. S. Angel Viji and Dr. J. Jayakumari, "*Automatic Detection of Brain Tumor based on Magnetic Resonance Image using CAD System with watershed segmentation" Proceedings of 2011 International Conference on Signal Processing, Communication, Computing and Networking Technologies. (ICSCCN2011). 978-1-61284-653-8/11©2011 IEEE.pp.145-150.*

4. Shubhangi Handore & Dhanashri Kokare," *Performance Analysis of Various Methods to Tumour Detection." IEEE (2015) International Conference on Pervasive Computing (ICPC), 978-1-4799-6272-3/15/(c) 2015 IEEE.pp.1-4.*