International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 08, August-2019

Automated Hybrid Algorithms for MRI Image Processing (Registration, Tumor Detection & Classification, Segmentation)

Ruchi Kumari Garg[1], Mr. Subhash Chandra[2]

[1] *M.Tech Computer Science Department, Rajasthan College of Engineering for Women, Jaipur*
[2]*Assistant Professor Computer Science Department, Rajasthan College of Engineering for Women, Jaipur,*

Abstract — MRI (Magnetic Resonance Imaging) is on indispensible diagnostics tool in medical science, especially in the diagnostics of diseases & ailments of human brain. MRI is unsophisticated medical imaging technique used to produce high quality image slices of human brain, which when combined form a 3-D picture of the brain. MRI imaging is widely used for diagnostics & detection of brain tumor due to its high resolution & capability to show brain structure, tumor's size location. The author has proposed hybrid algorithms employing image processing techniques on MRI image for tumor detection & classification. Coefficient in top, down & left, right (horizontal) traversal of image is complete to localize the tumor maximum & fuzzy logic identifies the part of brain affected & generates a list of symptoms & prognosis.

Keywords— Tumor, Magnetic Resonance Imaging, Fuzzy logic, Tumor detection, Artificial Intelligence.

I. INTRODUCTION

The brain is the central and most important part of the human body. Any damage called stroke can affect the working of brain. Brain tumors occur when cell process is interrupted within the brain. These tumors can be benign or malignant type. Bengine tumors can be treated and are not life threatening while Malignant tumors are dangerous and can lead an individual to death. These tumors can be spreaded in two or more than two lobes of the brain. Examination of MRIs manually performed by experts is a difficult task and time-consuming. So it is important to make an automated system to reduce the difficulties and time taken. Different brain tumor detection algorithms have been developed so far but automatic detection and segmentation of tumors is still challenging. The main aim of this tool is to detect the tumor and its affected lobes so the individual can be treated properly.

II. OBJECTIVES OF STUDY

[1.] Design & Development of a new hybrid algorithm for MRI image segmentation, tumour classification and disease detection.
[2.] Automatic registration/portioning of input MRI image for brain part identification and disease classification.
[3.] Detection and segmentation of tumour and classification of an effected brain area and its management, prognosis and symptoms.
[4.] Implementation of GOI based interface for user selectable references and standards.
[5.] Development of automatic tumour staging technique for staging and grading of tumour and its management.
[6.] Detection and classification of malignant or non-malignant tumour based on SVM or other artificial intelligence classifier.
[7.] Feasibility of portation of a develop algorithm (MATLAB implementation) to a FPGA targets for ASIC based synthesis and production.
[8.] Reduction in space and time complexity of existing analysis and prediction algorithm.
[9.] Automatic determination of growth/disease spread over time analysis using consecutive time spread image analysis.

III. EXISTING TECHNIQUES

In thi paper author explains that the brain tumor is detected by pretreatment, which is the first step in this intermediate filter and by the use of oblique and diagonal anti-image masks that receive pretreatment. After the skull hide the adipose tissue and other unwanted details get smoothing. The previously processed image is segmented using K-Mean segmentation and object tagging using HOG, an easy-to-use HOG with extraction feature. So the texture and color feature is extracted here in the system that is used to discover the area that interests you and the SVM tool is used for pattern mapping and pattern matching. a system is proposed that can be used to divide MR images to detect and identify a brain tumor. The tumor area and its type of tumor are found. [1]

In this paper author describes that Image processing plays a vital role in today's world. It has an important application in biomedicine. The proposed system for tumor diagnosis was developed from brain MRI images. This method makes the diagnosis in many stages. In pre-treatment filtering is performed on brain MR images. In the image segmentation phase, the K-mean grouping method is used to divide the MR image. After the tissue features are extracted from the gray MR image

using the GLCM method, these extracted features are given as inputs into the artificial neural network to classify the MR image into a normal and abnormal (subtle) image. [2]

The proposed methodology aims to detect brain tumor from CT / MRI brain images. The detected lesion is then fragmented using image processing algorithms and morphological processes are performed to obtain vital parameters such as Mean, Standard Deviation, Third Moment, Area, Entropy of the image. The results are presented in two tables, one for CT and the other for MRI. From the numerical results obtained explains that abnormal state values are always high. [3]

In this paper author emphasized that By using a GUI-based program, much better results than traditional tumor detection techniques can be get, is shown here. Using GUI-based software allows changing parameters without rewriting the software and allows for fast and efficient detection of tumors. The results are clearly more accurate and faster. [4]

The conclusions that can be drawn from this research: Elastix and Camino is a potential tool in medical image processing. Gimias is another medical image processing tool made in the frame. In this research, a survey paper was completed by reviewing 15 tools. This paper reviews current medical image processing tools and recommends the use of several medical image processing tools in medical image analysis. The range includes only medical imaging tools. Each medical image processing (MIP) tool has its own limitations. The recommendation for future work includes improving the survey tool number in the following paper. [5]

In this paper author explains that MRI image segmentation is an important but inherently difficult problem in medical image processing. In general, it can be solved using conventional and direct image processing techniques. Due to the characteristics of MR images, the development of automated algorithms is difficult. There is significant variation among patients in the signal intensity of the same tissue type due to the effect of partial size and latent noise and a wide range of imaging parameters, which affect the severity of the tissue. This paper proposed an effective classification system based on a density-based aggregation approach for brain tumor detection. MATLAB simulation is performed on different brain images and the tumor is detected using the OTSU method for image division and optimal global threshold. The discovery of brain tumors is a great help for doctors and a blessing for medical imaging and the industries that produce CT scans and MRIs. [6]

In this paper author study that MRI images are best suited to detect brain tumors. In this study, digital image processing techniques are important for detecting brain tumors with MRI images. Pretreatment techniques include different methods such as filtering and contrast enhancement, and edge detection is used to smooth the image. Pre-processed images are used for post-processing operations such as threshold, graph, hashing and morphology, which is used to enhance images. [7]

In this paper, author improved version of the Sobel edge discovery is proposed to divide the brain tumor into an MR image. The edges resulting from the proposed method have less false edges and have closed borders. Thus, brain tumors extracted from the proposed approach are better than tumors extracted using sobel edge detection. Moreover, in terms of three criteria, the proposed method was found to be superior compared to conventional methods. In the future, the closed contour algorithm can be improved to increase the area of the area and reduce the thickness of the boundary lines of the regions. [8]

In this paper author described that there are many simple greedy schemes for building hierarchical clusters, where the whole project of hierarchical clustering can use some justification. There is always a hierarchical aggregation approaching the optimal level at each level of accuracy, simultaneously. K assembly problem, reduce assembly cost. The algorithm returns a hierarchical aggregation so that each group, the induced aggregation k is guaranteed to be within an eight-factor optimization. The standard heuristics of the hierarchy aggregation is greedy and bottom-up single-link action, average link, full linkage, our algorithm similar in efficiency and simplicity, but topdown works. In this tumor paper, they are grouped into one block and this individual group is grouped together to form another new block or this individual block is divided into multiple mass based on the distance between objects. This paper describes brain tumor detection using MRI, and a division using a watershed algorithm and clustered tumor cells using hierarchical clusters. The results show the efficient tumor detection using the hierarchical aggregation algorithm. The shape and size of the tumor is described. [9]

In this paper author described a different type of PID controller tuning technique is applied to control the speed of the nonlinear hybrid electric vehicle. From the results, shows that PSOGSA tuned PID controller gives excellent performance in all respects. The maximum override and leveling time is much lower to achieve the desired speed so that current and torque are optimized as well as battery operation. They concluded that the Hybrid Gravity Control (PSOGSA) hybrid particle optimization control unit (SOGL) gives the best performance and can be applied to other nonlinear systems to improve performance. The efficiency of the car's driving range may be improved and the fuel efficiency of electric vehicles may also be improved. [10]

In this paper, author conclude that the technological landscape of tumor detection is dynamic and goes through changes in the current context of its use and applicability in the field. Based on the observations and finding the following observations: The fragmentation algorithm used to detect tumors may not belong to a particular class of algorithm, they may be very diverse and belong in several ways. Some researchers use probability-based methods and some use a statistical approach to divide the tumor portion. Probability methods are used freely when everything is observable or at least partially observable. However, some of these techniques are not immune to noise. The most common segmenting algorithm is the active contour method, neural networks and SVM. However, it is known that the accuracy of the device algorithm depends on the features used. In this context, it was found that most researchers use a consistent method, where the advantage of color and texture is the main group of advantage used to detect the tumor because it is characterized by being distinctive in nature. However, for evaluation purposes for their system, we found that very few or few authors are considering an agreement between rater based on criteria that can help validate their work against the basic truth. [11] This paper author helps us to learrn the basics of medical image processing, try it out as a plastic combination of science and art, and most importantly understand the ultimate goal in medical image processing - helping patients. In this paper, they outlined some important applications in medical image processing. [12]

IV.METHODOLOGY

(A) System Block Diagram

In this block diagram we can see 1st we input MRI image then adaptive noise filtration process is done then next process is skull detection & centre orientation then tumor is detected using Bhattacharya score vertical- horizontal minimum maximum area then next process is tumor segmentation then tumor area side of brain affected lobes display then symptoms & prognosis display.

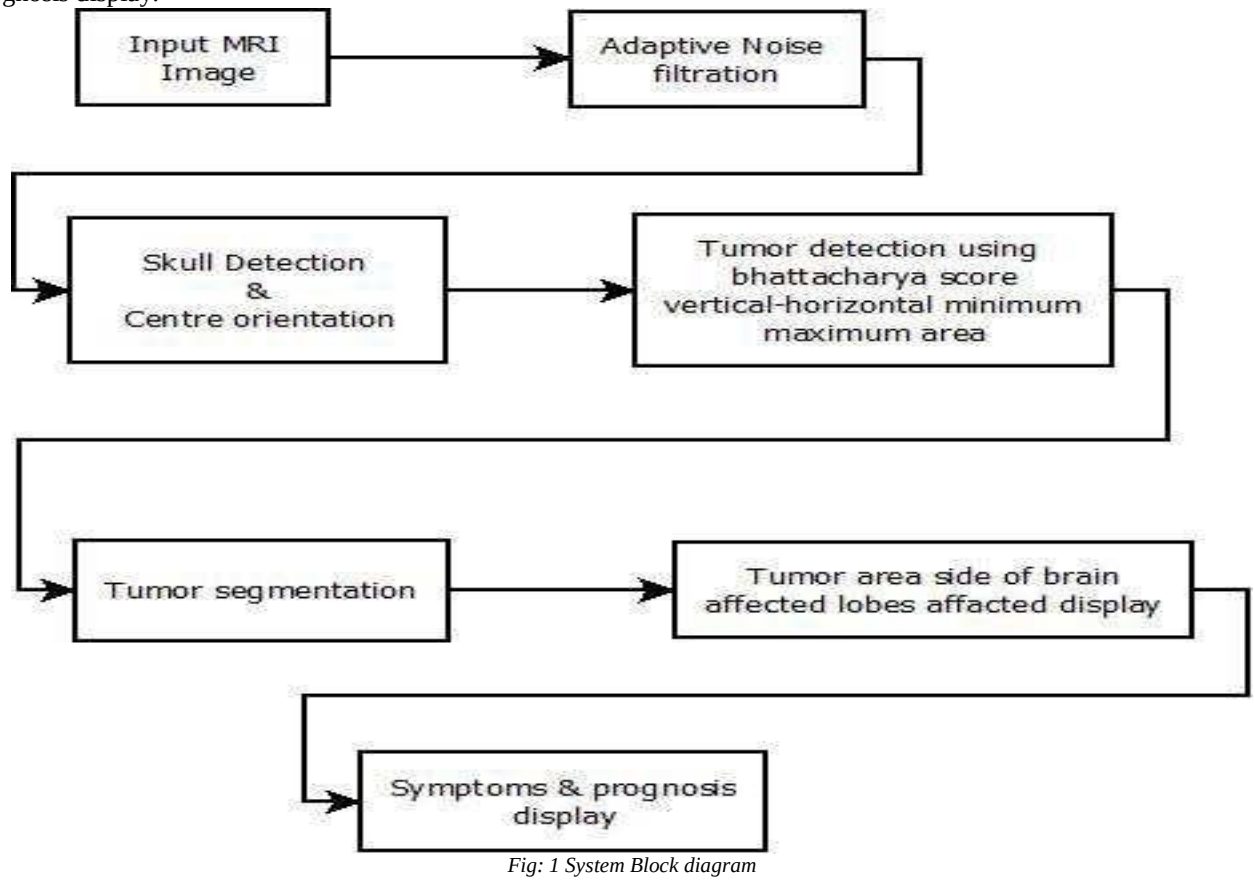


Fig: 1 System Block diagram

(B) Noise Filtration

An MRI image is used as input image. The image is pre-processed by different techniques as high pass filter, median filter, and watershed algorithm. High pass filtering makes the image sharper by intensity value whereas median filter preserves edges while removing noise. It smoothes image. A gray scale image is needed for watershed algorithm to filter the input image.

(C) Tumor Detection & Localization

For tumor detection we take skull segmented image in I & skull boundary Im = I (:, midx: - 1: 1), Ref I = I (:, midx : end), RefIMask = m(: , midx : end) and then starti = round[STATS.BoundingBox(2)], endi = round[STATS.BoundingBox(2) + STATS.BoundingBox(4)] and Initialize fact = 16 and then compute Bhattacharya score from top down as BC_diff_Td = score(Im,RefI,ImMusk,RefIMusk,starti,endi,fact) then Create new figure window plot (starti:endi, BC_diff_TD) titled 'score plot for vertical direction'.

Now, define vert_scale = 30 & compute largest decreasing segment as [topy1, downy1] = find largest_decreasing_segment(BC_diff_TD, vert_scale) then Compute topy = topy(1) & downy = downy(1) and hold on. plot(top y+ starti- 1, BC_diff_TD(topy), 'r.' , downy + starti - 1, BC_diff_TD(downy), 'm.', 'markerSize', 10) then compute topy = topy + starti -1 & downy = downy + starti-1 then hold off & create new figure window. Then Im = (Im(topy:downy,:))' ImMask = (ImMask(topy:downy,:))' RefI = (RefI(topy:downy,:))' RefIMask = (RefImask(topy: downy,:))' & then startj =1; endj = floor(min(STATS.BoundingBox(1)+ STATS.BoundingBox(3) - midx+1, midx- STATS.Bounding.Box(1)+1)) then compute bhattacharya score from left to right BC_diff_LR = score (Im,RefI,ImMask,RefImask,startj, endj,fact).

Initialize horz_scale=30 & compute[leftx1,rightx1] = find_largest_devresing_segment(BC_diff_LR horz_scale) then compute the following leftx = leftx1(1), rightx =rightx1(1), leftx2 = leftx1(1), rightx2 = rightx1(1) then compute the following leftx=leftx+midx+startj-1, rightx=rightx+midx+startj-1, m_right=mean2(I(topy:downy, leftx:rightx)), m_left = mean2 (I(topy: downy), 2 * midx-rightx:2 * midx -leftx). Now initialize isleft = 0 and check if m_left>m_right then leftx1 = 2*midx – rightx, rightx1 = 2*midx-leftx, leftx=leftx1, rightx = rightx1, isleft = 1 and it ends.

Now check if isleft = 1 then a condition start that is if it is false then plot(midx+startj : midx+endj, BC_diff_LR, 'r'), hold on, plot(leftx,BC_diff_LR(leftx2)),'c.', rightx, BC_diff_LR(rightx2, 'y'.) . If it is true then plot(midx-endj:midx-startj,-

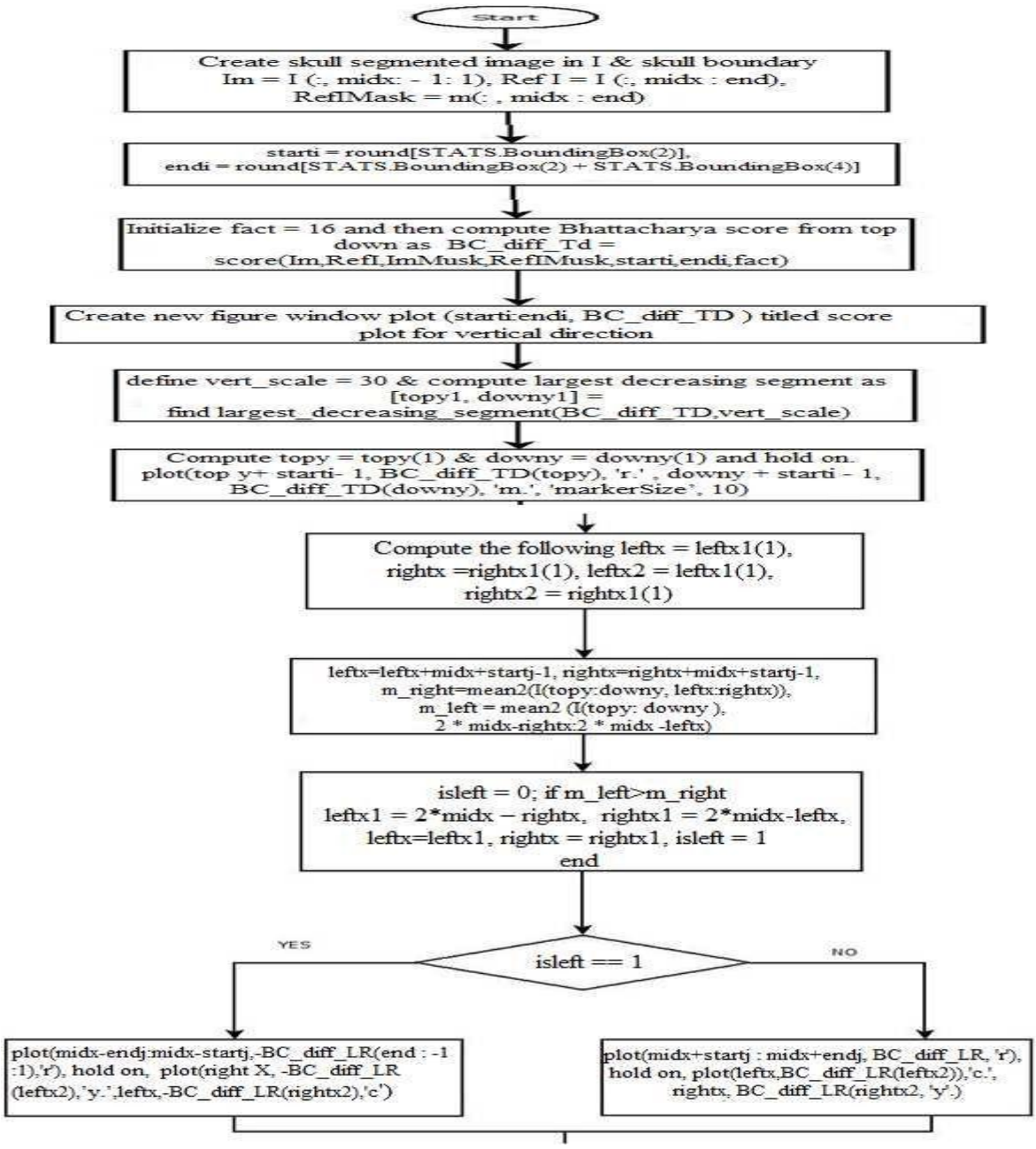
BC_diff_LR(end : -1 :1),'r'), hold on, plot(right X, -BC_diff_LR(leftx2),'y.',leftx,-BC_diff_LR(rightx2),'c') then Create new figure window & display skull_image, with title 'Tumor Detection', hold on then plot([leftx rightx], [topy, topy], 'r'], plot([leftx rightx], [downy, downy],'g'), plot([leftx, leftx],[topy downy],'c'); plot([rightx, rightx],[topy downy],'y') then cenX = (leftx + rightx) / 2 cenY = (topy + downy) / 2, hold on, plot(cenX,cenY,'+','color','r'); drawnow; hold on, plot([midx midx],[1 h], 'linewidth', 2); drawnow; hold on, plot([1 w],[0.40*h 0.40*h], 'linewidth', 2); drawnow; hold on, plot([1 w],[0.45*h 0.45*h], 'linewidth', 2); drawnow; hold on, plot([1 w],[0.55*h 0.55*h], 'linewidth', 2); drawnow;hold on, plot([1 w],[0.85*h 0.85*h], 'linewidth', 2); drawnow.

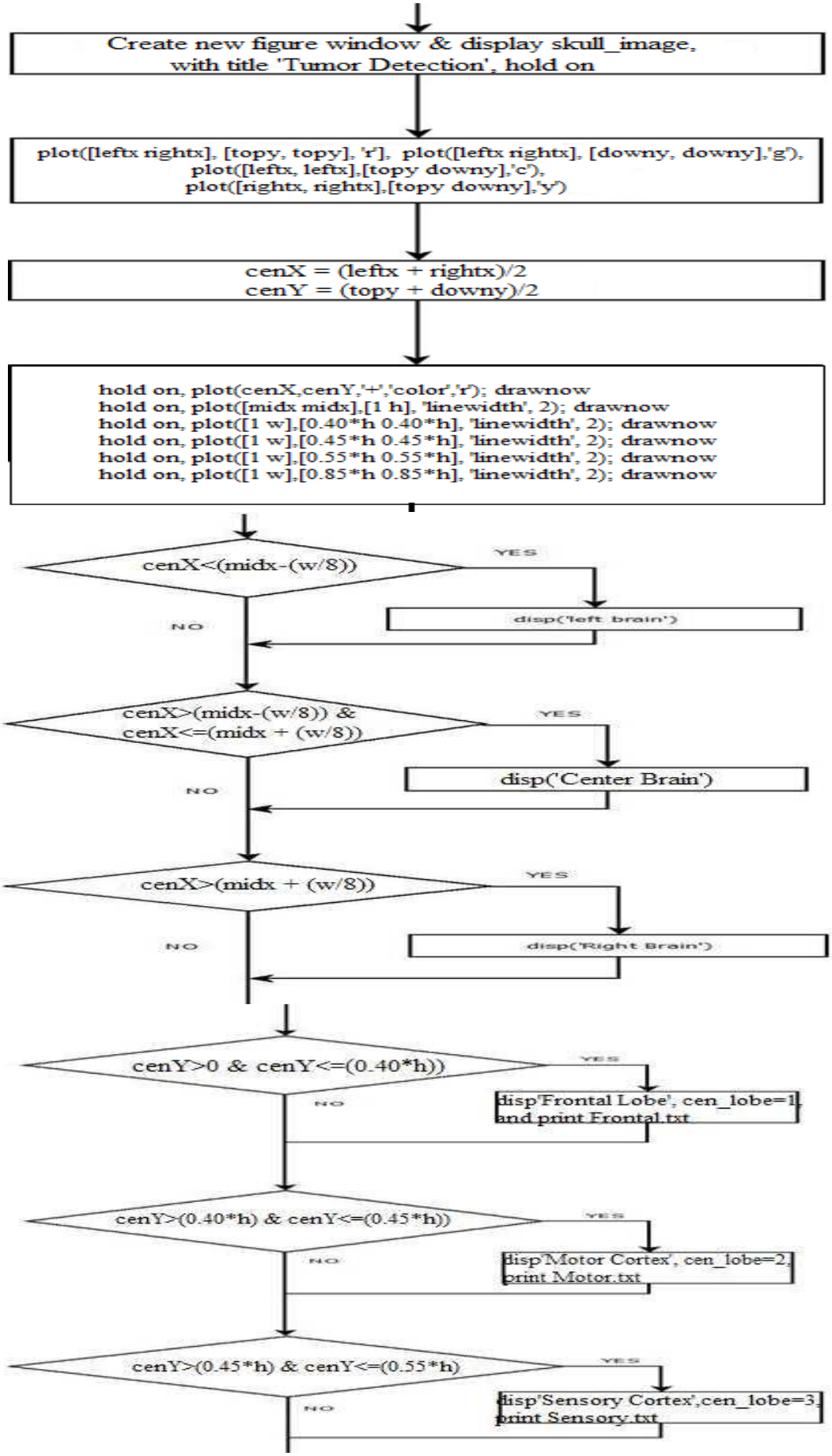
A condition will be checked that cenX<(midx-(w/8)) then display ('Left Brain'). Next condition will be checked that is cenX>(midx-(w/8)) & cenX<=(midx + (w/8)) then display ('Center Brain'). Next condition is cenX>(midx + (w/8)) then display ('Right Brain') then next condition is cenY>0 & cenY<=(0.40*h)) then display 'Frontal Lobe', cen_lobe=1, and print Frontal.txt.

For cenY>(0.40*h) & cenY<=(0.45*h), display ('Motor Cortex') and cen_lobe=2, and print Motor.txt. For cenY>(0.45*h) & cenY<=(0.55*h), display 'Sensory Cortex', and cen_lobe=3 and print Sensory.txt.

For cenY>(0.55*h) & cenY<=(0.85*h), display 'Pariental Lobe & Temporal Lobe', and cen_lobe=4, and print Parietal.txt and Temporal.txt.

For cenY>(0.85*h) & cenY<=h then display 'Occipital Lobe' and cen_lobe=5 and print Occipital.txt. Then cen_lobe_prev = cen_lobe and algorithm will be Stop.




Create new figure window & display skull_image, with title 'Tumor Detection', hold on
plot([leftx rightx], [topy, topy], 'r'), plot([leftx rightx], [downy, downy],'g'), plot([leftx, leftx],[topy downy],'c'), plot([rightx, rightx],[topy downy],'y')
cenX = (leftx + rightx)/2
cenY = (topy + downy)/2
hold on, plot(cenX,cenY,'+','color','r'); drawnow
hold on, plot([midx midx],[1 h], 'linewidth', 2); drawnow
hold on, plot([1 w],[0.40*h 0.40*h], 'linewidth', 2); drawnow
hold on, plot([1 w],[0.45*h 0.45*h], 'linewidth', 2); drawnow
hold on, plot([1 w],[0.55*h 0.55*h], 'linewidth', 2); drawnow
hold on, plot([1 w],[0.85*h 0.85*h], 'linewidth', 2); drawnow
cenX<(midx-(w/8))
YES
disp('left brain')
NO
cenX>(midx-(w/8)) & cenX<=(midx + (w/8))
YES
disp('Center Brain')
NO
cenX>(midx + (w/8))
YES
disp('Right Brain')
NO
cenY>0 & cenY<=(0.40*h))
YES
disp'Frontal Lobe', cen_lobe=1, and print Frontal.txt
NO
cenY>(0.40*h) & cenY<=(0.45*h))
YES
disp'Motor Cortex', cen_lobe=2, print Motor.txt
NO
cenY>(0.45*h) & cenY<=(0.55*h)
YES
disp'Sensory Cortex',cen_lobe=3, print Sensory.txt
NO

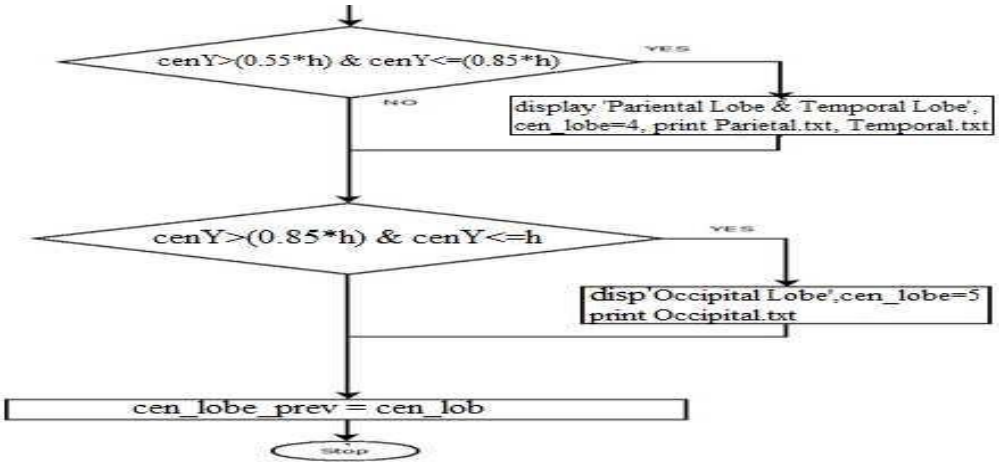


Fig. 2 Tumor Detection & Localization

(D)Tumor Segmentation & Area Compulation

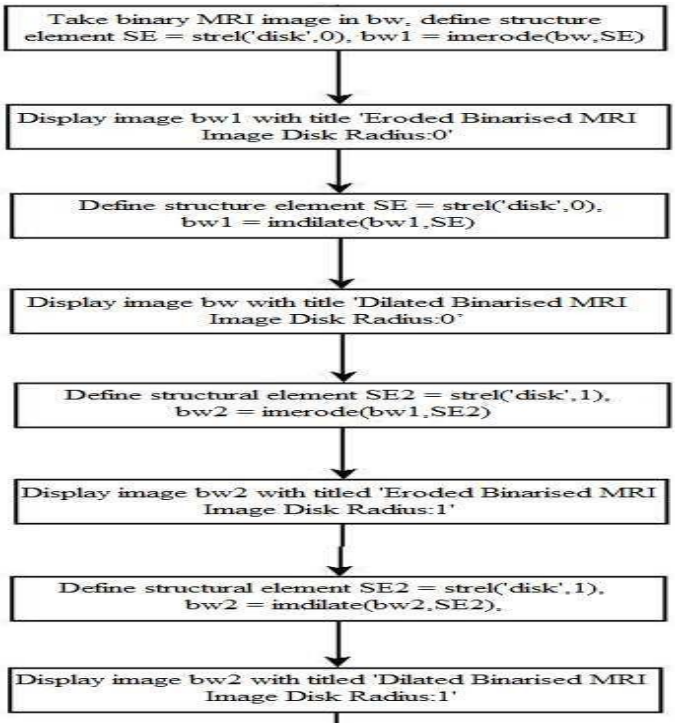
We start the algorithm by taking binary MRI image in bw, define structure element SE = strel('disk',0), bw1 = imerode(bw,SE) then display image bw1 with title 'Eroded Binarised MRI Image Disk Radius:0'.

Define structure element SE = strel('disk',0), bw1 = imdilate(bw1,SE) then display image bw with title 'Dilated Binarised MRI Image Disk Radius:0'.

Define structural element SE2 = strel('disk',1),bw2 = imerode(bw1,SE2), then display image bw2 with titled 'Eroded Binarised MRI Image Disk Radius:1'. Define structural element SE2 = strel('disk',1), bw2 = imdilate(bw2,SE2), then display image bw2 with titled 'Dilated Binarised MRI Image Disk Radius:1'.

Define structural element SE3 = strel('disk',6), bw3 = imerode(bw2,SE3) then display image bw3 with title 'Eroded Binarised MRI Image Disk Radius:6'. Define structural element SE3 = strel('disk',6), bw3 = imdilate(bw3,SE3) then display image with title 'Dilated Binarised MRI Image Disk Radius:6'.

Now, compute rec_width = rightx – leftx, rec_height = downy – topy and tumor_area = rec_width * rec_height then display tumor area. Now it checks topy conditions and downy conditions and initialize brain_affected_area=1 and check if cen_lobe_prev~=top_lobe then brain_affected_area=brain_affected_area+1.Next condition checks if cen_lobe_prev~=bottom_lobe then brain_affected_area=brain_affected_area+1 and display brain_affected_area and open result.txt using fid = fopen('Result.log','w+') and print brain_affected_area, tumor_area and close & save file using fclose(fid) then pause for 1 sec. and print result.log then call main menu then algorithm will be stop.



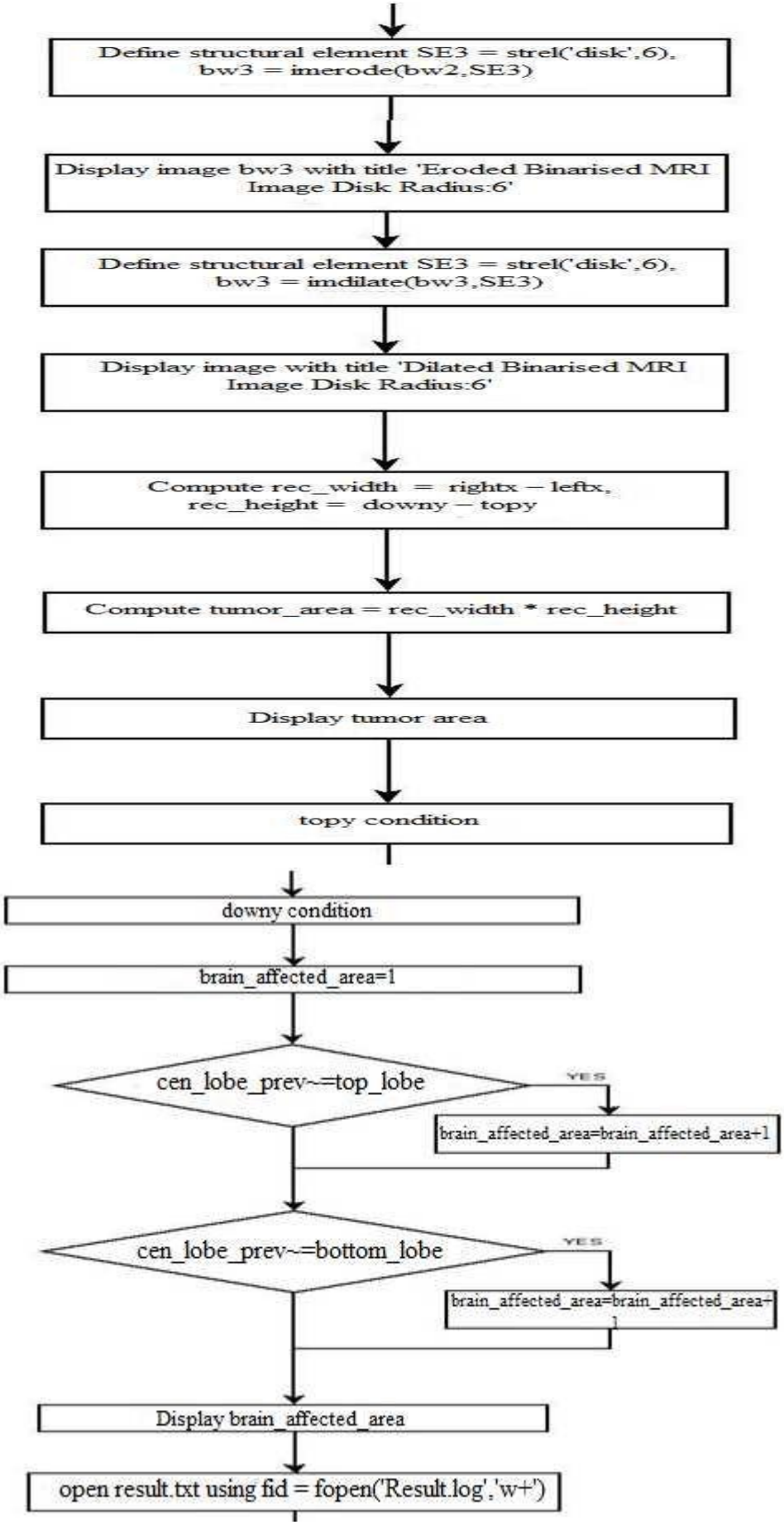


Fig. 3 Tumor Segmentation & Area Computation

V. RESULTS

In the result of the our proposed work 1st we start the algorithm then a main menu window will be open here is option for user selection. Here 1st we enter the input image of MRI then our algorithm detect orientation of this input image and it detect the skull boundary. Then we goes to next process and detect tumor area then tumor area demarcation of this image then after goes to next process we have horizontal & vertical Bhattacharya score plot of our input image. And then we detect tumor affected side and affected lobe with count. Here we used 6 MRI images of brain in this algorithm. There result are tabulated in below table 1.

Fig. 4 shows, a MRI image which we are used as input image.

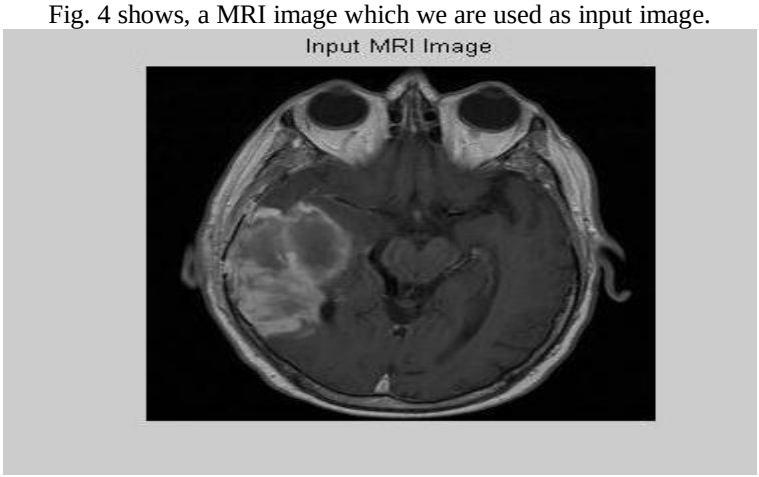


Fig.4 MRI Image

Fig. 5 shows our MRI image with skull boundary & orientation detected image.

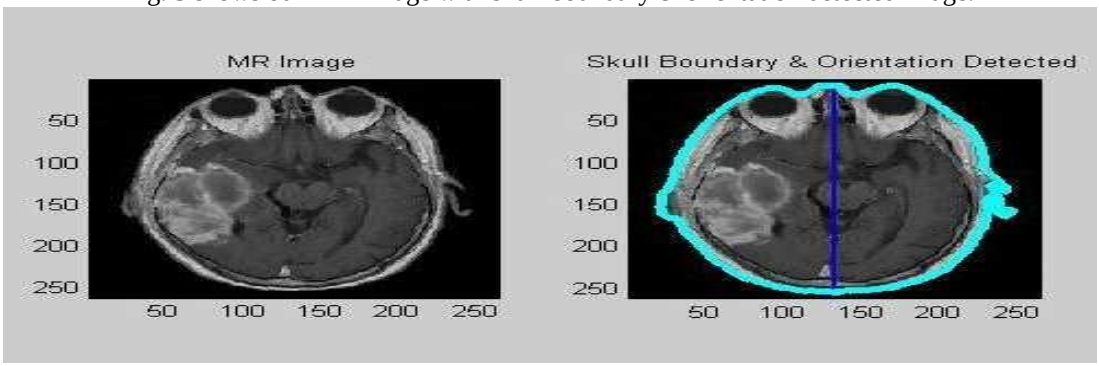


Fig. 5 MRI Image With Skull Boundary

Fig. 6 shows tumor detected area of our input MRI image.

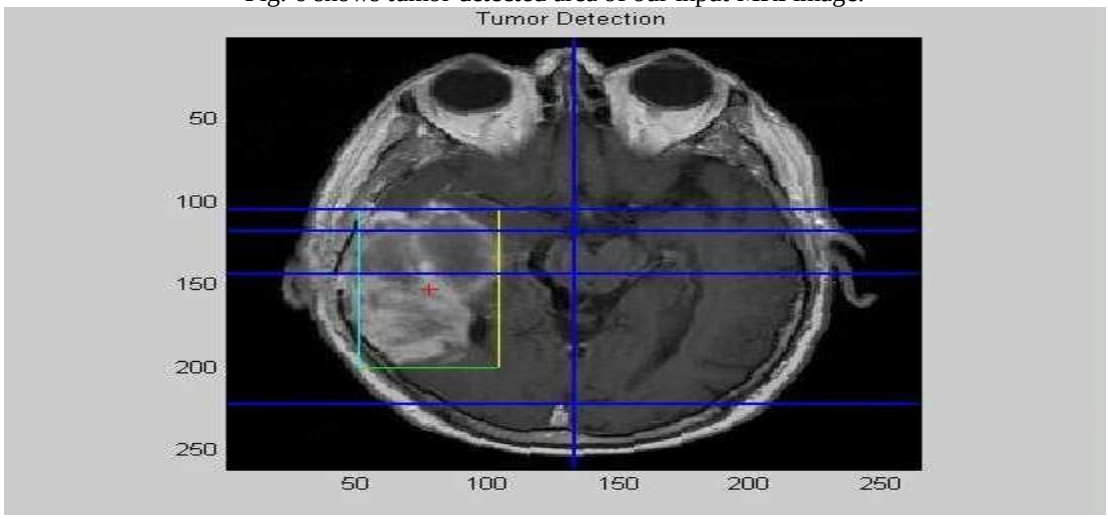


Fig. 6 Tumor Detected Area

Fig. 7 shows score plot for horizontal direction and score plot for vertical direction.

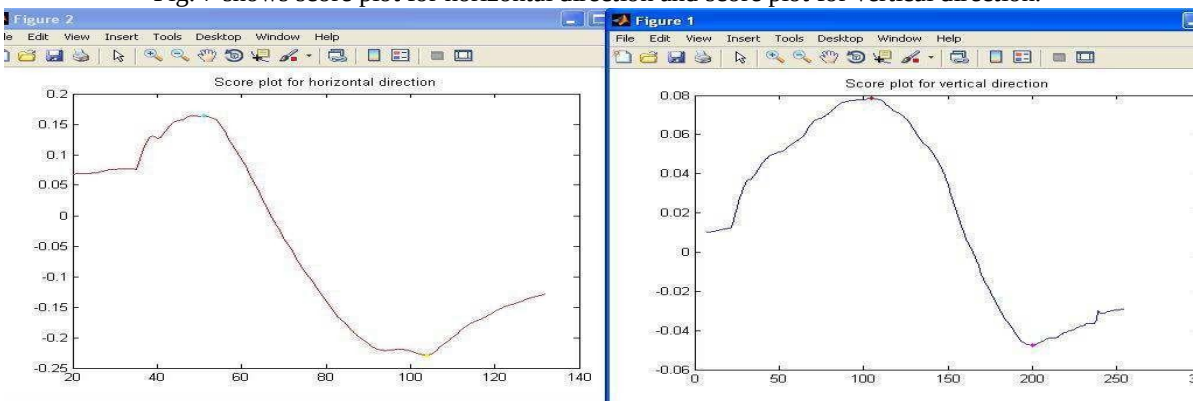


Fig. 7 Horizontal & Vertical Bhattacharya Score Plot For Image1

Tumor Affected Side and Affected Lobe Name with Count for all 6 images are tabulated here.

Sr. No.	Image1	Tumor Side	Lobes Affected Name	Lobes Affected Count
1.	Image2	Left brain	Parietal lobe & temporal lobe motor cortex	2
2.	Image3	Right brain	Frontal lobe, sensory cortex	3
3.	Image4	Right brain	Frontal lobe, parietal lobe & temporal lobe	3
4.	Imag5	Left brain	Motor cortex, parietal lobe & temporal lobe	3
5.	Imag6	Left brain	Frontal lobe, sensory cortex	3
6.	Imag7	Centre brain	Parietal lobe & temporal lobe	2

Table: 1 Tumor Affected Side and Affected Lobe Name with Count

CONCLUSIONS

The author has proposed comprehensive automated hybrid algorithm for MRI image processing for brain tumor detection & classification. The proposed system not only detects & segments a tumor but also computes important parameters such as tumor size /area also. The system is able to locate the part of brain affected by tumor & display associated symptoms & prognosis correlation. The proposed system combines many techniques such as brain area/boundary segmentation for skull detection, Bhattacharya coefficient in horizontal & vertical directions for tumor detection, rule based fuzzy logic for brain part affected & morphology for tumor segmentation. The proposed system has been tested on a set of MRI images & the successful implementation is depicted by the results above.

FUTURE SCOPES

Medical imaging techniques & image processing based inference techniques are rapidly evolving with advances in computer sciences & availability of processing power & memory availability. The proposed system is able to work as a complete tool for brain MRI analysis for tumor detection & segmentation but the developed system should also keep evolving with the latest technology to meet future challenges & expectation one of the sought after changes would be to enable 3-D image processing instead of 2-D MRI slide processing to analysis tumor anatomy in detail. Another important improvement would be to detect nearly blood used & their interaction with the tumor. Also to quality as a complete tool it may detect other abnormality such as primal space disorders, brain tissue degeneration etc.

REFERENCES

[1.] Swapnil R. Telrandhe, Amit Pimpalkar, Ankita Kendhe "Detection of Brain Tumor from MRI images by using Segmentation &SVM" IEEE 2016.
[2.] Kalpana U. Rathod, Prof. Y. D. Kapse "MATLAB Based Brain Tumour Extraction Using Artificial Neural Network" IJRITCC 2016.
[3.] M. Sudharson, S.R. Thangadurai Rajapandiyan and P.U. Ilavarasi "Brain Tumor Detection by Image Processing Using

MATLAB" IDOSI Publications 2016.
[4.] Esmail Hassan and Abobakr Aboshgifa "DETECTING BRAIN TUMOUR FROM MRIIMAGE USING MATLAB GUI PROGRAMME" ijcses 2015.
[5.] Siau-Chuin Liew, Lay-Khoon Lee "A Survey of Medical Image Processing Tools" Researchgate 2015.
[6.] Pankaj Kr. Saini, Mohinder Singh "BRAIN TUMOR DETECTION IN MEDICAL IMAGING USING MATLAB" IRJET 2015.
[7.] Vipin Y. Borole , Sunil S. Nimbhore , Dr. Seema S. Kawthekar "Image Processing Techniques for Brain Tumor Detection: A Review" IJETTCS 2015.
[8.] Asra Aslama, ,Ekram Khan , M.M. Sufyan Bega "Improved Edge Detection Algorithm for Brain Tumor Segmentation" Elsevier B.V 2015.
[9.] R. Rajeswari , G. Gunasekaran "Tumor Detection and Segmentation Using Watershed and Hierarchical Clustering Algorithms" IJIRCCE 2014.
[10.] Avtar Singh , Er. Amrit Kaur "Speed Control of Hybrid Electric Vehicle Using Optimization Algorithm" IJARCCE 2014.
[11.] Mandhir Kaur and Dr. Rinkesh Mitta "Survey of Intelligent Methods for Brain Tumor Detection" IJCSI International Journal of Computer Science Issues 2014.
[12.]Dr. J. Thirumaran , S. Shylaja "Medical Image Processing – An Introduction" International Journal of Science and Research (IJSR) 2014.