

# Automatic Brain Tumor Detection using SVM and FBB Algorithm

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**Abstract-** This Paper represents an algorithm for detection of brain tumor in MR images. Brain tumor is an uncontrolled growth of intracranial cells. The early detection of cancer can be helpful in complete curing the disease. According to the most research in developed countries shows results that just because of inaccurate detection the numbers of people who have brain tumor were died. As the use of digital images has rapidly increased over the past decade, Radiologists by using computed Tomography (CT scan) and Magnetic Resonance Imaging (MRI) examine the patient physically. In surgical & medical assessments, brain tumor segmentation using MRI images is very difficult and important task. For diagnosis of brain tumor MR image is visually examined by the physician. However this method of manual detection resists accurate tumor detection and more time consuming. To overcome these problems, this paper uses computer aided techniques such as SVM for extraction of tumor is key component to automate specific radiological tasks for the characterization of anatomical structures and regions of interest and FBB algorithm to locate tumor area on the MRI images [1]. At the end of process the tumor detected from the MR image and its exact position and the shape also determined. This technique allows the segmentation of brain tumor tissue with accuracy, improved performance and robustness; it also reduces the effect of noise.

**Keywords-** Fast bounding box, Magnetic Resonance Imaging, Support vector machine.

## I. INTRODUCTION

In accordance to the increasing age population, cancer has become a worldwide problem. The early detection of cancer can be helpful in curing the disease completely. Most of the natural cells are getting old or damaged, it vanishes and new cells are replaced with them. Sometimes, this reproducibility may go wrong & new cells are produced when body does not need them & the old and damaged cells don't disappear. Therefore, the illimitable and uncontrollable increase of cells results in the brain tumor [4]. Effective brain tumor segmentation is difficult task due to complex brain structure as each tumor being of different shape, size, location and intensity. For diagnostic system, early and accurate detection of tumor, edema & necrotic tissues is very important.

Fast Bounding Box (FBB) using symmetry is nothing but, an approximate segmentation technique which explores the symmetry of brain structure to locate a bounding box around the tumor used to locate the exact position of tumor[3]. For classification purpose SVM technique is get used. As Support Vector Machines (SVMs) is mainly used for pattern classification problems and nonlinear regressions. Without using any prior knowledge SVM has ability to learn the nonlinear distribution of the real data and also known as classification algorithm for analyzing high-dimensional data. A supervised learning technique as support vector machine (SVM) generates input-output mapping functions using a set of labelled training data[2]. The mapping function can be either a classification function, the category of the input data or regression function. Technique used is as fast bounding box technique help to find out the exact location of tumor and an effective extraction technique as support vector machine is used for the Classification purposes which can extract tumor from skull part of brain.

## II. SYSTEM ANALYSIS

MRI brain images for analysis are chosen from the databases which are obtained from doctors and stored database. The implemented system has mainly four modules as shown in the figure 1,

- 1) Image Acquisition
- 2) Pre-Processing
- 3) Fast Bounding Box algorithm
- 4) Support Vector Machine technique

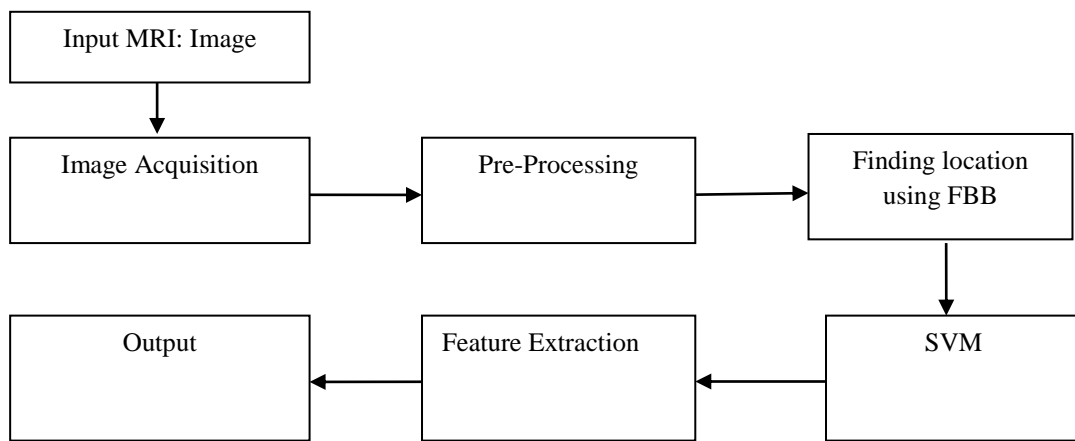


Figure 1 Block diagram of automatic brain tumor detection technique

As shown in the figure 1, input is provided as MR images. Basically images contain soft brain tissues such as WM, GM and CSF are surrounded by bone structure as intracranial structure. The WM, GM and CSF tissues of the brain are represented by gray, white and black colors respectively except the background black color. Images are converted to joint photo graphic (.jpg) format, and then median filter is used to remove noise from the given input images, to locate the area of interest fast bounding box algorithm is used and using support vector machine tumor can get extracted area calculated.

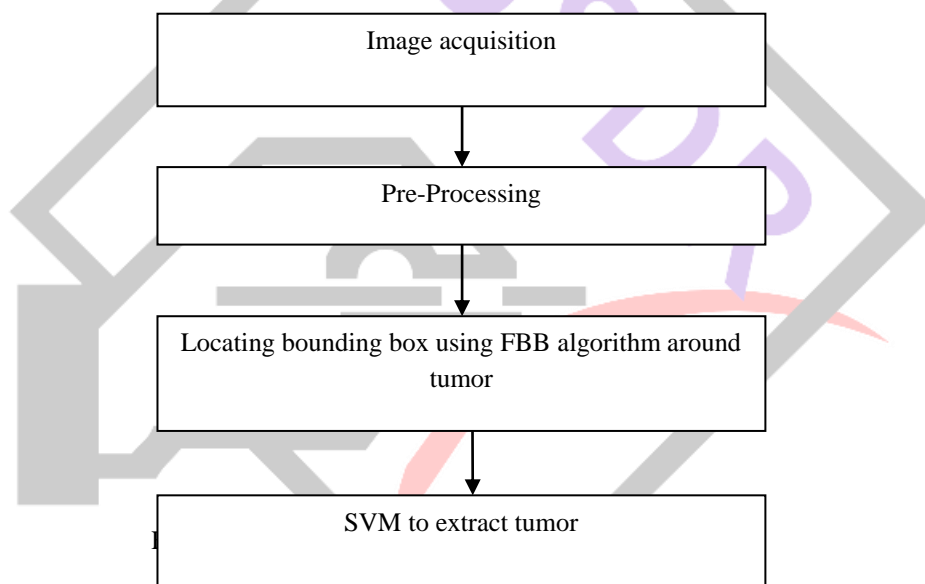


Figure 2 Flow Chart for the Execution of the Technique

#### A. Image Acquisition-

Intracranial brain structure images contain soft brain tissues such as WM, GM and CSF are surrounded skull. The WM, GM and CSF tissues of the brain are represented by white, gray and black colors respectively except the background black color. Images are converted to joint photo graphic (.jpg) format using micro-DICOM software for further processing to reduce the complexity and processing time. There are different brain imaging modalities like MRI, positron emission tomography (PET), diffusion tensor imaging (DTI), computed tomography (CT) and single photon emission computed tomography (SPECT). There are some advantages of MRI over other imaging modalities are its excellent discrimination of high spatial resolution of soft tissues. MRI provides rich information about anatomical structure.

#### B. Pre-processing-

In this step image gets converted according to the need of the next level which is filtering. It performs filtering of noise and other important changes in the image and edges sharpening in the image [4]. RGB to gray conversion and Resizing also takes in this section. It uses filters of different types like Gaussian filter, contour let transform approach and median filter for noise removal from MRI images. The possibilities of arrival of noise in modern MRI scan are very less due to the thermal effect. The main aim

of this paper is to detect and segment the tumor cells. But to fulfil the system it needs the process of noise removal which get carried out in pre-processing.

### C. Fast Bounding Box Technique-

As in each input MRI slice an axial view of image is provided; there is a left-right axis of symmetry of the brain image. An abnormality in the brain is called tumor typically perturbs this symmetry. Thus on the right side an axis-parallel rectangle that is from its reflection about the axis of symmetry on the left side is dissimilar, hence the gray level intensity histograms of the inside of the two rectangles are most dissimilar and the outside of the rectangles are similar accordingly. The used function in this technique utilizes and identifies the region of change with two very rapid searches along the horizontal and vertical direction of the brain image [4]. Using Bhattacharya coefficient (BC) Similarity between two normalized gray level intensity histograms is measured. When two normalized histograms are the same, the BC between them is 1 and when two normalized histograms are completely different from each other, the respective BC value is 0. For a 2D MR image, consider as a T1C (T1 after injecting a contrast agent) MR slice, the FBB casts the problem as a change detection problem. The technique can be described as below:

1) Image halving based on brain structure symmetry The MR image first needs to be divided into two parts: one half of the brain acts as a reference image  $R$ , and the other half as a test image  $I$ . After the skull contour is detected by Otsu's thresholding, the geometrical axis of symmetry of the skull is then applied to halve the image [1].

2) Bounding box detection based on Bhattacharya coefficient (BC) The FBB finds the region of abnormality  $D$  which is an axis-parallel rectangle by considering both horizontal and vertical score functions defined by the Bhattacharya coefficient (BC) [1].

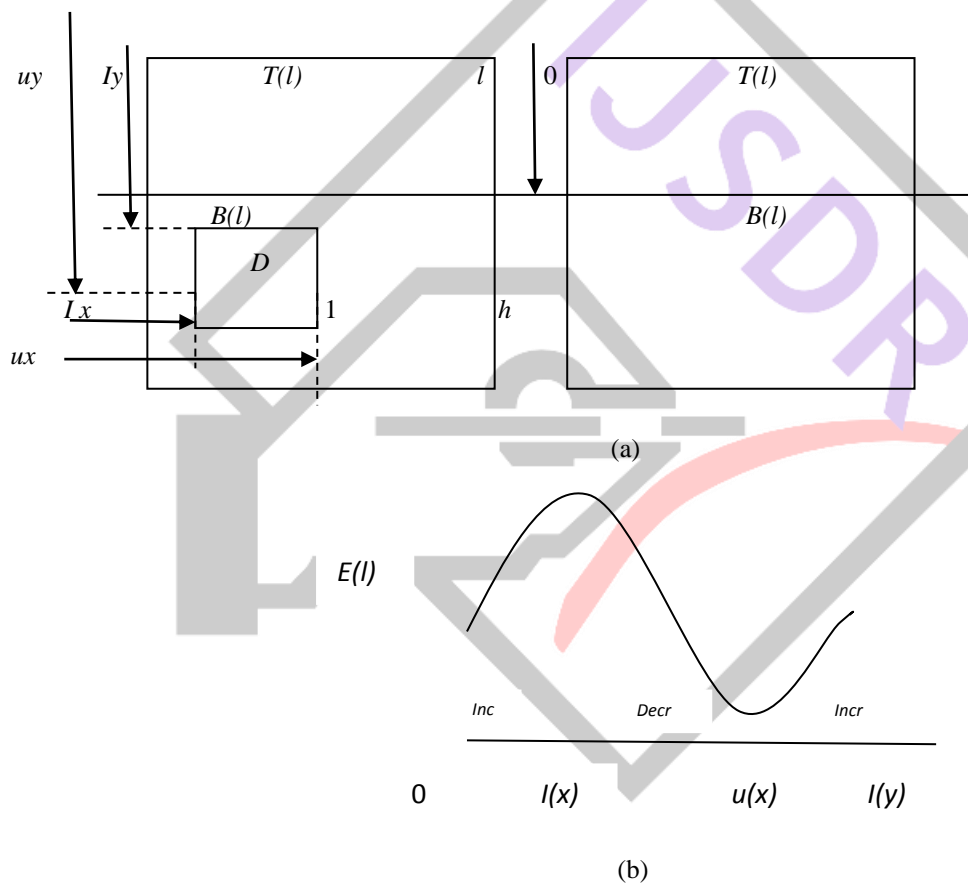


Figure 3 (a) Finding Bounding Box  $D$  from test image  $I$  using reference image  $R$ . (b) Score function plot observed in vertical sweep.

As illustrated in Fig. 3 (a), the rectangle region  $D = [l_x, u_x] \times [l_y, u_y]$  represents the region of change having a tumor.  $T(l)$  and  $B(l)$  are the top and bottom sub rectangles of the image respectively, from the top of the image divided at a distance  $l$ . FBB then finds the accurate  $l_y$  and  $u_y$  values in a vertical sweep (as by moving the dotted line vertically) are using a score function at the top of image.

According to this, FBB finds the best values for  $l_y$  and  $u_y$ , in a vertical sweep as using function:

$$E(l) = BC(P_l^{T(l)}, P_R^{T(l)}) - BC(P_l^{B(l)}, P_R^{B(l)}) \quad (1)$$

Where  $P_l^{T(l)}$  denotes the normalized intensity histogram of the region  $T_{(l)}$  in test image.  $P_R^{T(l)}, P_l^{B(l)}, P_R^{B(l)}$  are defined accordingly [4]. Bhattacharya Coefficient (BC) between two normalized histogram  $a(i)$  and  $b(i)$ , denoted by,

$$BC(a, b) = \sum_i \sqrt{a(i)b(i)} \in [0,1] \quad (2)$$

This technique uses Fast Bounding Box algorithm to detect the region of interest (ROI). Bounding Box approach is based on an unrecognised change detection method that searches for the most dissimilar region (axis- parallel bounding boxes) between the right and the left halves of a brain in an axial view MR slice. This change detection process uses a novel score function based on Bhattacharya coefficient computed with gray level intensity histograms. In short axis of symmetry on an axial MR slice is found which divides brain in two halves left (l) and right (R). One half serves as test Image and the other half supplies as the reference image. It uses Bhattacharya coefficient to detect a rectangle  $D$  which represents the region of interest between images  $I$  and  $R$ . After the ROI is detected, several post processing operations are carried to clearly locate the tumor part in the brain. The basic purpose of post processing is to show only that part of the image  $D$ , which has the tumor [3].

#### D. Support vector machine-

Support Vector Machines (SVM) has recently gained eminence in the field of pattern classification and machine learning. By realizing a linear or non-linear separation surface in the input space classification is achieved[2].

SVM is a fast iterative algorithm for identifying the Support Vectors of a given set of points. This algorithm works by maintaining a candidate Support Vector set and uses a greedy approach to pick points for inclusion in the candidate set. Because of other points already present in the set the addition of a point to the candidate set is blocked hence it uses a backtracking approach to prune away such points. To speed up convergence with the nearest pair of points from opposite classes support vector machine algorithm initializes. Then uses an optimization based approach to increment or prune the candidate Support Vector set. The algorithm makes repeated passes over the data to satisfy the KKT (Karush-Kuhn-Tucker) constraints[2].

### III. RESULT ANALYSIS

First step is to acquire image using the “Select Image” button. The GUI shows the chosen image from database in figure 4. MRI images as magnetic resonance images are selected as input images. These MRI images are mainly classified using the A,B,C names.

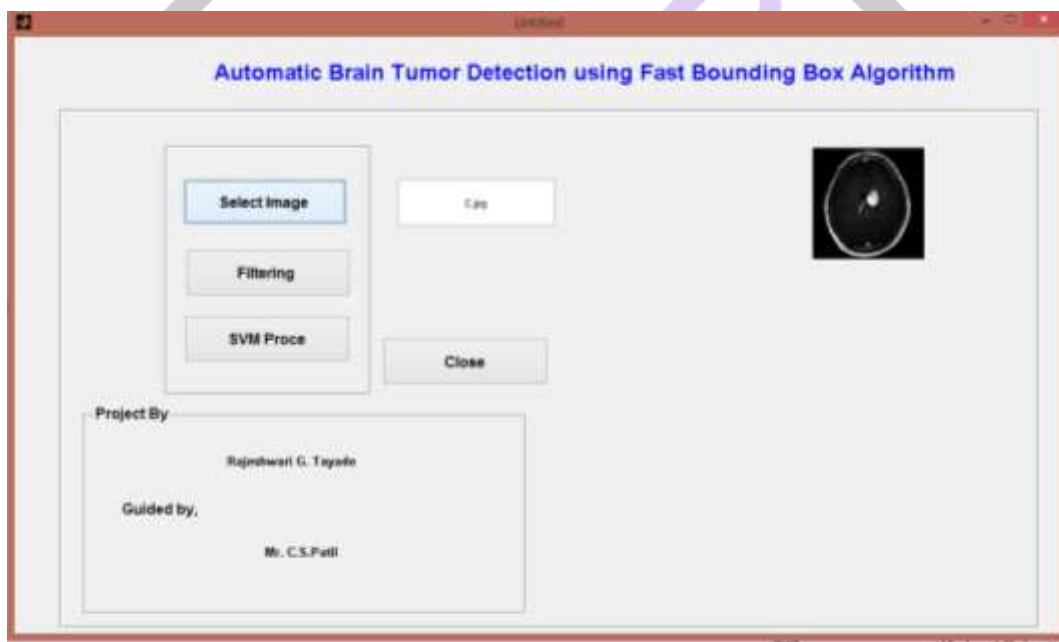


Figure 4 GUI with displayed acquired image

Once the image is acquired the filtering button is enabled. The second step is to perform filtering operation on the image to improve the image quality by reducing the salt and pepper noise and locate tumor using fast bounding box technique. “Filtering” button is used to perform image filtering as indicated in figure. After this step “SVM Proce” button becomes active.

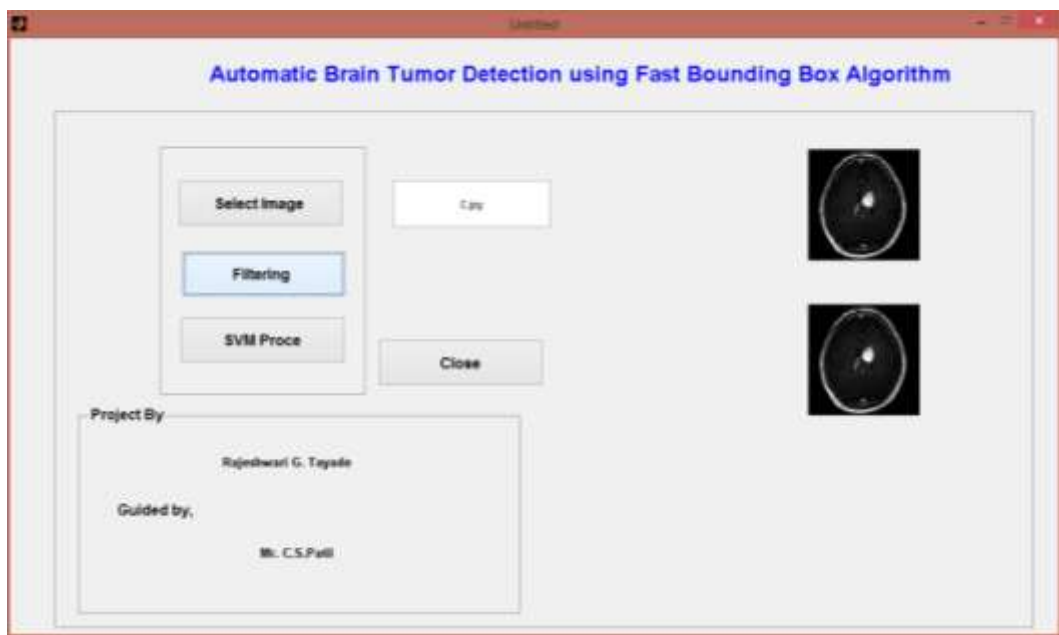


Figure 5 GUI with displayed filtered image

The third step is to enhance an image using support vector machine, which is used to extract tumor from given input MRI image.

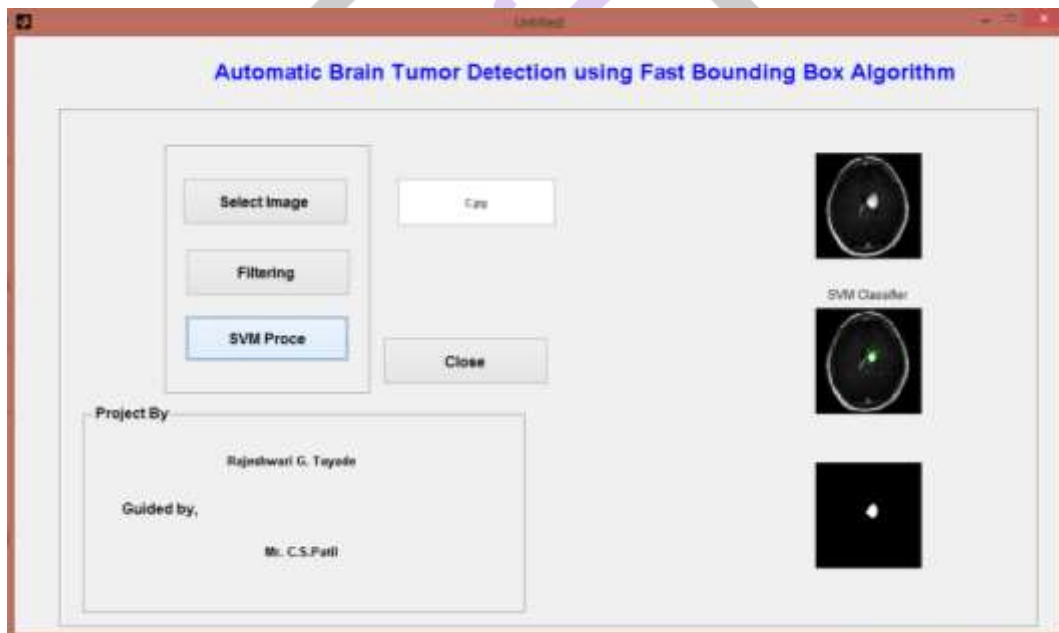
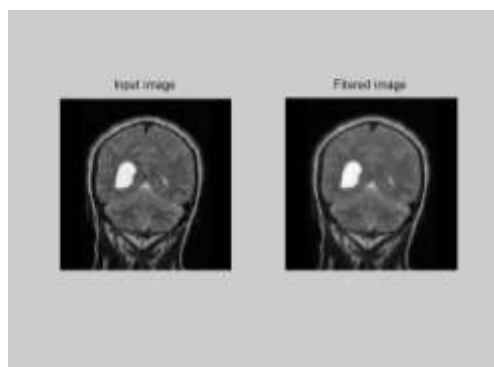
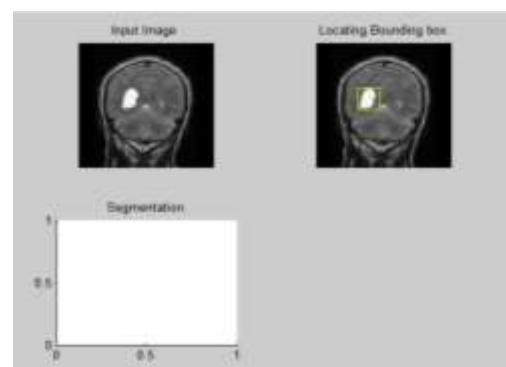


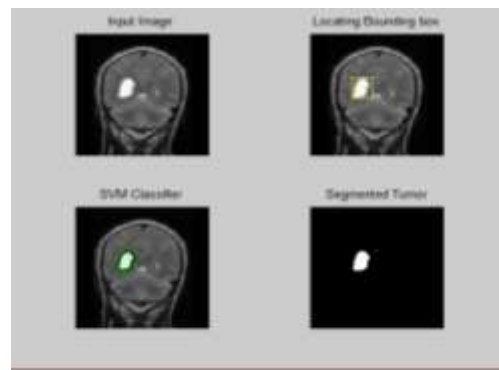
Figure 6 GUI with displayed resultant images



(a)



(b)



(c)

Figure 7 Tumor segmentation process for A input image (a) Original input image (axial slice) with output filtered image (b) Image having location of tumor using bounding box (c) Output image of segmented tumor using SVM classifier.

Figure shows the actual results behind GUI using another image, In the first step input image is selected as input MRI image using “Select Image” button, after that filtering process gets executed using “Filtering” button, where as filtering process is used to remove noise from image as shown in figure 7 (a). Fast bounding box technique is used to locate the exact position of tumor as shown in figure 7 (b) and figure 7 (c) SVM technique used for the efficient segmentation of brain tumor which provides the result as extracted tumor.

#### IV. CONCLUSION

In this paper, a fully automatic technique for brain tumor detection using MRI images is presented. This technique is carried out in three steps: The first step is a pre-processing in which the unwanted & extra parts of skull are removed and image acquisition and image enhancement is carried out which includes filtering method to removing noise from MRI images. After that in second step FBB algorithm is used to locate tumor and also determines region of interest by locating position of tumor. Further SVM classifier is used to extract tumor from MRI image. By comparing the results of this approach to the existing approaches it clearly shows more reliable and accurate results. Future work includes extending the technique into 3D application and also to find out the size of tumor.

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