DETECTION AND SEGMENTATION OF BRAIN TUMOUR USING FAST BOUNDING BOX AND WAVELETS

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(May- 2015)

DECLARATION

I hereby declare that the dissertation proposal entitled, **"DETECTION AND SEGMENTATION OF BRAIN TUMOUR USING FAST BOUNDING BOX ALGORITHM AND WAVELET"** submitted for the M. Tech. Degree is entirely my original work and all ideas and references have been duly acknowledged. It does not contain any work for the award of any other degree or diploma.

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CERTIFICATE

This is to certify that **Ravinder Singh** Registration Number **11310691** has completed M. Tech. dissertation proposal **"DETECTION AND SEGMENTATION OF BRAIN TUMOUR USING FAST BOUNDING BOX ALGORITHM AND WAVELET"** under my guidance and supervision. To the best of my knowledge, the present work is the result of his original investigation and study. No part of the dissertation proposal has ever been submitted for any other degree or diploma. The dissertation proposal is fit for the submission and the partial fulfilment of the conditions for the award of M. Tech Electronics and Communication Engineering.

Date:

Gaurav Sethi
Assistant Professor

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I express my gratitude to my parents for being a continuous source of encouragement and for their financial aids given to me. Finally, I would like to express my gratitude to all those who helped and supported me.

Ravindra Singh **..................................**

ABSTRACT

Today's modern medical imaging research faces the challenge of detecting brain tumor through Magnetic Resonance Images (MRI). Normally, to produce images of soft tissue of human body, MRI images are used by experts. It is used for analysis of human organs to replace surgery. For brain tumor detection, image segmentation is required. For this purpose, the brain is partitioned into two distinct regions. This is considered to be one of the most important but difficult part of the process of detecting brain tumor. Hence, it is highly necessary that segmentation of the MRI images must be done accurately before asking the computer to do the exact diagnosis. Earlier, a variety of algorithms were developed for segmentation of MRI images by using different tools and techniques. In our methodology we detect the tumour using Fast Bounding Box algorithm along with wavelet transform due to this we compare the area using three method known as Manually, FBB and by using Threshold method. At last we compare the three methods by calculating the area and we found area calculated by using FBB is 4394 $pixel^2$ which is better than two methods used to compare the results.

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Chapter 1

Introduction

1.1Background

Image processing in the field of medical sciences plays an important role in diagnosis of the disease. It helps in easy diagnosis of the disease which is present in interior part of the body that it helps in visualising the interior parts without much complexity. A doctor can do effective surgeries without affecting much parts of the body. Surgery is a crucial part of the diagnosis of the disease. There is wide range of applications of medical science imaging and there are various techniques through which medical imaging can be done. For example, CT-scanners, MRI, Endoscopy and X-ray imaging technique etc. By taking the advantages of these techniques we can capture the internal view of the body and then from those images we can detect the abnormalities and disease. From the all prior mentioned medical imaging techniques one of the oldest techniques is X-Ray imaging techniques,which was invented in 1895. Digital image processing techniques are developed much after this. For the real time digital imaging CT-scanner, MRI and other means are used which gives the image on the monitor and this technique is very well known as fluoroscopy.These days digital image processing is fastest growing technology in almost every field such as Biometrics, Satellite images, Astronomy, Security and many more digital image processingincludes Image display and printing, Image editing and manipulation, Image enhancement, Feature detection, Image compression etc. Few areas of image processing are Noise removal, Contrast adjustment, Edge detection, Region detection and segmentation, Image compression.

One of the most common brain diseases Brain tumor which has taken away many lives As per the IARC it is estimated more than 126,000 people diagnosed for brain tumor per year around the world with more than 97,000 mortality.[1] The statistics shows that there is low survival rate of brain tumor patients . From many decades brain tumor disease has been the center of attention of thousands of researchers, around the world. To detect and confirm the presence of tumor Magnetic resonance

(MR) imaging and CT scan of head are the most common tests and by image processing we can identify its location for selecting treatment options. Surgery, Radiation therapy, and Chemotherapy are the different option for the treatment of brain tumor presently. There are several factors on which Treatment options and recommendations depends, which includes the size, type, and grade of the tumor, if tumor puts pressure on the vital parts of the brain, whether it spreads to other parts body or the CNS , patient's preferences, possible side effects and overall health. Above all, to minimize the fatal results, accurate detection of the type of brain abnormality is very essential for treatment planning.

1.2 Background of brain tumor

A brief overview of brain structure and tumors, brain imaging using magnetic resonance imaging (MRI), characteristics of brain tumors, and some theory about machine learning and its contributions which helps in the diagnosis of ailments are explained in this section.

1.2.1 Anatomy of brain Overview

The human brain is a very specialized and important organ. All the controlling functions of body are centered at brain and also it allows body to manage with our environment. All the actions thinking, words, thoughts and feelings are managed in the brain. For the purpose of thesis structure of tissueand anatomical parts of the brain are explained in this section. Inhuman brain, left side is an axial slice MR image, and right side is the color coded version of image left side. Gray matter and white matter are the two main tissue of the brain. Brain along with tissue consist of various fluids like cerebrospinal fluid (CSF) that consists of glucose, salts, enzymes, and white blood cells.to protect from injury CSF fluid flows through the ventricles around the 4 brain and the spinal cord .Meninges is one another tissue which covers the brain.

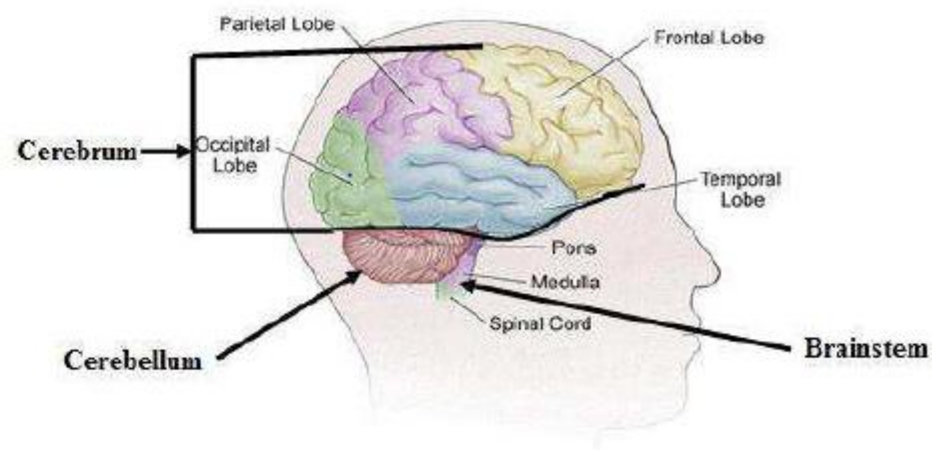

Figure 1, Structure of human brain

1.2.2 Brain Tumors

An abnormal mass of tissue in which some cells grows and multiply uncontrollably in an abnormal manner are the cause of tumor. In case of brain tum or the cells grows up within the skull and obstruct the activity of brain. A damage like damaging the brain nerves and healthy tissues can be caused by a tumor as it increase pressure in the brain, by shifting the brain or pushing the brain against the skull. Depending upon the type of cell affected by the brain tumor size of tumor, cancerous and noncancerous etc. are the basis classification of brain tumor. As declared byWHO, there are more than 120 types of brain tumors. Tumour is assigned through a grade I-grade IV.

1.2.3 MRI Brain Imaging and Characteristics of Brain Tumors

To study the brain tumor different imaging modalities are available like magnetic resonance imaging, computed tomography(CT), positron emission tomography(PET), single photon emission tomography(SPECT), out of these modalities computed tomography and magnetic resonance imaging are widely used because of their widespread availabity. The techniques has ability to produce high resolution images of pathological tissues and normal anatomical structure.

1.3 Overview of digital image processing

Processing of images by means of a digital computer refers to as digital image processing. Digital image processing uses various algorithms to process and manipulate images. The very first step is to digitize the given Image by sampling on a discrete grid and after sampling each pixel using a finite number of bits is quantized. The obtained digitized image is processed by a computer. And after all processing to display a digital image there is need of conversion into analog signal, which is scanned onto a display. After converting the image into bit information, processing is performed. One of the applications is to improve the pictorial information so that it could be better perceived that is the enhancement of image. This has various applications particularly in industry for quality check of various products. There are many other applications such as image restoration, compression.

1.3.1 Few applications:

- **Face detection**: face detection detects features of face and ignore all other objects such as the building behind the face, tress and bodies. It depends upon computer technology which establishes sizes and location of faces in digital images.
- **Signature verification**: It deals with digital signature such that the information provided by the sender such that sender is authenticated person.
- **Traffic monitoring**:This application uses images or videos for image processing the fundamental job is acquition of data and detection of incident.
- **Biometrics**: it is automatic identification of human through their characteristics. It recognize the authorized user may be from a group or individual.
- **Medical imaging**:it is one of the major application of image processing. It is a technique to create and process images of human body which can be used for clinical purposes. For example, X-ray images, CT scan, MRI, Ultrasound etc.

1.3.2 Steps in digital image processing:

- **Image acquisition:** It is a process of acquiring an image by means of sensors and this step generally involves pre-processing which is scaling.

- **Image enhancement**: It refers to highlighting or sharpening of features like boundaries, edges or contrast.This process is generally manipulation of pixels such the resulting image is better than the original image. This is basically a subjective approach.
- **Image restoration**: Restoration is applied to minimize the effects of degradations. It differs from image enhancement at enhancement is concerned with more extraction or highlighting of featuresof image.it is objective process. Effectiveness of restoration depends upon knowledge of degradation.
- **Image compression:** It is a process to decrease the idleness of image which can reduce the space required to store and image or transmit image. There are two kinds of compression one is lossless and other is lossy.
- **Morphological Image Processing:** It is based upon set theory. Number of operators exists for analysis the binary images. Morphological image processing is generally used to find out the edges of the image, contours, segmentation, filling of holes. This technique is based on template that is structuring element. Structuring element is compared with various elements present in image.
- **Segmentation:** It is a process of partitioning an input image into constituent parts of objects. It is a one of most difficult step in image processing.
- **Representation and description:** It takes output of segmentation stage and extract attributes description of objects which can be used for some further computer processing.
- **Recognition and Interpretation:** It is an process of assigning a label to the object based in the information provided by its descriptor
- **Knowledge base:** Itcontrols the interaction between the modules. It guides the operation of each module.

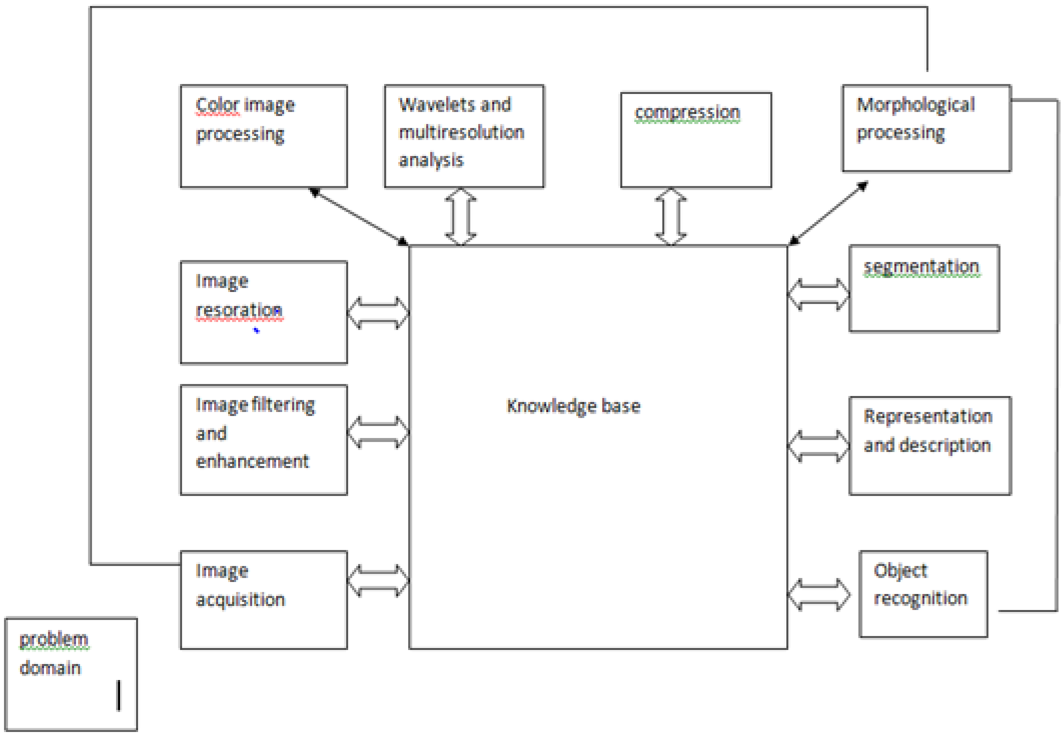

Figure2, Steps of image processing

1.4 Basic block diagram

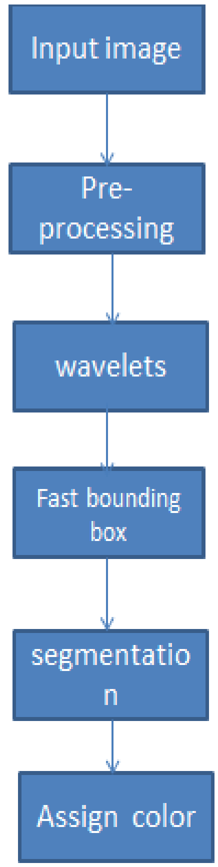

Figure 3, Basic block diagram

1.5 Haar Wavelet Transform

From the last 20 years the wavelets has been used widely for the image processing in the image processing the transform theory plays a key role. In many image processing field the wavelet transform are used means image transform techniques are used in image encoding, decryption, restoration, and for the enhancement of an image. In order to preserve the good quality or details of an image the Haar transform is used. In this we eliminate or discard the high intensity components, HH or very low intensity components i.e. LL when we apply the Haar transform which results in the fast processing and hence we process only LH and HL components. In Haar wavelet transformation technique, achieve low pass filtering by taking the averages of two adjacent pixels but in high pass filtering we take the difference between two adjacent pixels. For the image decomposition first in columns and after that in image rows independently we apply Haar transform which gives a pair of low pass and high pass filter. Due to this it produces subsequently four sub-bands and these four sub–bands are LL1, HL1 and LH1, HH1. In my dissertation or thesis report I am using the Haar wavelet transform for the decomposition.

1.6Fast Bounding Box Algorithm

Fast Bounding Box (FBB) algorithm is an algorithm which operates in two different sequential steps that is given below.

- The inputs which can be a CT image or a MR slice are supposed to be processed individually, and thus we find out the rectangle axis-parallel.
- The second step is the clustering of these bounding boxes so that we can identify the specific area that actually surround the defected area i.e. tumor or edmas present in the CT brain image.

This algorithm is an automatic algorithm which is very fast and has approximate segmentation technique. By making the use of this algorithm we locate bounding box which is a rectangle axis-parallel around the tumour on CT image MR slices. The input which is given to this algorithm is from the set of either from the set of CT images database or from MR. Thus we obtained an output which is the subset that contains tumours and this tumour part is labelled with bounding box i.e. axis-parallel rectangle which shows the tumour part, thus we can segment and extract the tumour part by making the use of fast bounding box.

1.6.1Locating a Bounding Box

In this part we explain the basic principle of FBB. For this algorithm we consider two images one is the test image and second is the reference image. It is based on the principle of change in detection in which a change in region is detected on the test image say 'I' when it is compared with the second image i.e. reference image say 'R'.

The part of the brain which has the tumor or abnormalities perturbs the symmetry that is present on CT image , now are task is to find that symmetry i.e. there exist left to right symmetry of axis on the brain. The axis parallel rectangle which is on the left side is very dissimilar than that of right side that is in case we consider the histogram of the rectangle which are most dissimilar , but in case of outerside the intensity histogram is quite similar. In this case we make the use of symmetry that speed up the detection process of brain tumor.

I is the image which denotes the test image and R is another image which denotes the reference image. The width (w) and height (h) of the test image I and reference image is same. A region of change or the region of interest (ROI) that contains the tumor between the test image I and the reference image R is formed which is represented by a rectangular box or region D and given as

$D=[I_x u_x] \times [I_y u_y]$.

Where,

I_x, ux, Iy, uy are unknown parameter

The change in the region D or rectangle is found out by fast bounding box algorithm that is by computing these four unknown parameters in two linear passes of the image. It finds the change in region on the basis of sweeps that is horizontal sweep $I_x$and u_x and vertical sweep I_y and u_y.

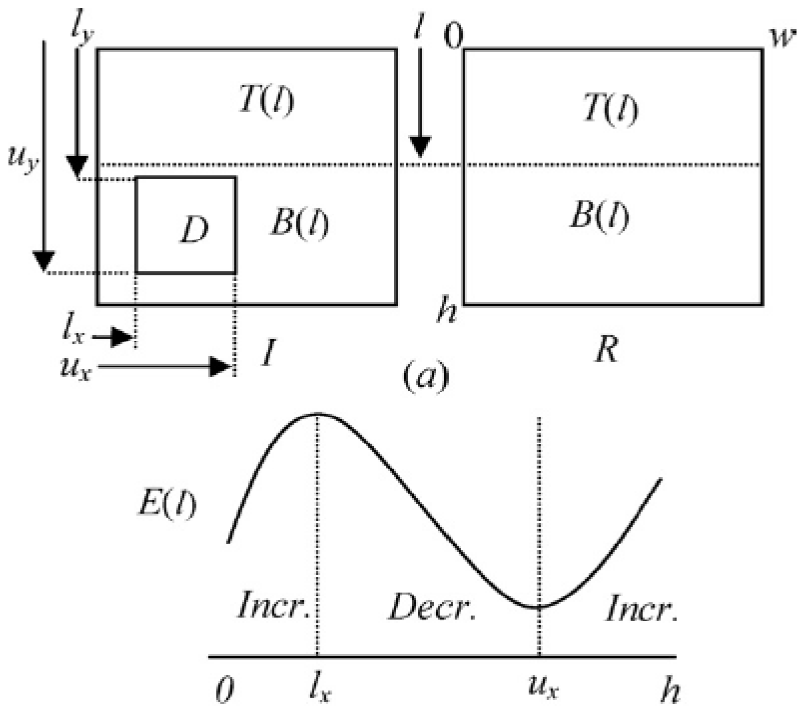

Figure 4(a), Anomaly D from test image I by using reference image R4, Figure (b), Energy plot of score function

over the pair of images it firstly finds I_y, uy the bestest value in the vertical sweep and then secondly finds I_x, ux the best values in the horizontal sweep. A score function is used in each sweep. As horizontal score function corresponds to vertical score function applied to the transpose of the image and here we describe the vertical score function only [2]. In order to define vertical score function, we consider the T (l) is the top and B (l) is the bottom part of the sub-rectangle of the image, from the top of the image it is divided at a distance 'l'.

$$T(l) = [0, w] \times [0, l]$$

and

$$B(l) = [0, w] \times [l, h]$$

So we can define vertical score function denoted by eqn. (a) mathematically as,

$$E(l) = BC(P_I^{T(l)}, P_R^{T(l)}) - BC(P_I^{B(l)}, P_R^{B(l)}),$$

The set of two normalized intensity histogram are how much similar is measured by the Bhattacharaya coefficients. BC coefficient are use to measure the similarity of two normalized histogram and mathematical expression for Bhattacharaya coefficient is given by,

Mathematically,

$$BC(a, b) = \sum_i a(i)b(i) \qquad \in [0,1]$$

Here,

$a(i), b(i)$Represents the normalized intensity histogram

$i =$ Indicates histogram bin.

In various field of computer vision application like registration, object tracking edge detection etc. BC is widely or successfully used.

$$BC(P_I^{T(l)}, P_R^{T(l)}) = \sum_i \sqrt{P_I^{T(l)}(i) \, , P_R^{T(l)}(i)},$$

And

$$BC(P_I^{B(l)}, P_R^{B(l)}) = \sum_i \sqrt{P_I^{B(l)}(i) \, , P_R^{B(l)}(i)},$$

The value of BC between the two stabilized histogram is corresponds to ‘1’ when they are similar and when it is dissimilar the value of Bhattacharaya-coefficient between them corresponds to ‘0’.From the equation it indicates that, from the set of two images when the top region $T(l)$ are similar and the bottom region $B(l)$ are dissimilar then the score function is large.

There are some properties of the score function $E(l)$ which helps us to fast localization of the axis-parallel rectangle D. in the fig.(b) it is clear indicates that the score function is changing first it increases and then decreases and again increases when I increases from 0 to h. thus these variations that is first increase then decrease and then again increase forms some segments which meet at points $l = l_y$ and $l = u_y$ which is the lower bound of the change of region D respectively. Hence, we can identify very quickly and easily the upper or lower bounds by plotting the score function. Similarly, left and right bound of the D can be identified or obtained by plotting the horizontal score function $I_x$andU_x. Due to the nature of the score function $E(l)$ there exist two proposition mathematically regarding to $I, R$and$D$.

For obtaining upper and lower bounds of score function we use proposition 1

Proposition 1. $U_D(l) \geq E(l) \geq L_D(l)$, *where*

$$U_D(l) = M_D(l) + \sqrt{\frac{|T(l) \cap D|}{|T(l)|}} BC(P_l^{T(l) \cap D}, P_R^{T(l)}),$$

$$L_D(l) = M_D(l) - \sqrt{\frac{|B(l) \cap D|}{|B(l)|}} BC(P_l^{B(l) \cap D}, P_R^{B(l)}),$$

$$M_D(l) = \sqrt{\frac{|T(l) \backslash D|}{|T(l)|}} BC(P_l^{T(l) \backslash D}, P_R^{T(l)}) - \sqrt{\frac{|B(l) \backslash D|}{|B(l)|}} BC(P_l^{B(l)}, P_R^{B(l)}).$$

Proposition 2. *If Assumptions (i), (ii) and (iii) hold, then $E(l)$ is (a) increasing for $0 \leq l \leq l_y$, (b) decreasing for $l_y \leq l \leq u_y$ and (c) increasing again for $u_y \leq l \leq h$, where $D = [l_x, u_x] \times [l_y, u_y]$.*

$$M_D(l) = c_1 \sqrt{\frac{|T(l) \backslash D|}{|T(l)|}} - c_2 \sqrt{\frac{|B(l) \backslash D|}{|B(l)|}}.$$

1.7 Image segmentation

As the segmentation it is clear from the name segments which means that partioning of an image into certain objects or parts i.e. we can say that segmentation is the process of dividing an image into certain parts or objects. In actual manner segmentation deals with various techniques to detect the edges, lines or points. In the digital image processing segmentation is the most difficult task. However, the more accurate is the segmentation process, the more likely recognition can be done. We can partition digital images into multiple segments i.e. pixels or sets with the help of image segmentation. We can change the representation of an image into other that is easier to analyze or meaningful.Different methods to achieve segmentation:

Image segmentation is done by using various method and some of which is listed below.

- Thresholding: In case of thresholding the classes of objects are done based upon a threshold value all the pixels falling under a threshold are grouped into one class.
- Clustering based: In case of spatial clustering grouping is performed in measurement space.
- compression based model
- histogram base model
- edge detection
- Region growing method: in case of region growing neighboring points are merged to make a bigger region.
- Partial differential equation
- level set method
- parametric method

1.8Median Filter

Imaging filter is used to remove the noise which is present in the images. In order to highlight the contour for the detection of edges, sharpening of edges the imaging filters are used, we can classify the image filter as linear or non-linear filters. Noise removal filter is used to remove the noise which is present in the images, but it is very difficult task or challenging too in case of the medical imaging.

Median Filtering is one of the non-linear methods which are used to remove the noise from the images. This filter is very effective in removing noise from the images and are most widely used, in removing the salt and pepper type noises. It moves throughout the image i.e. pixel to pixel and replaced the values with median value of the neighbor pixel. The pattern of the neighbour is known as the window which moves freely to entire image means pixel to pixel.

Chapter 2

Literature Review

Primarily, a few papers on the detection and segmentation of brain tumour are reviewed to understand the concept and then started my work to achieve my goal. In the health care society, the most common fatality in the current scenario are brain tumour pathologies. Hence, for treatment planning which can minimize the fatal result, the accurate detection of the type of the brain abnormalities are highly essential. To achieve the accurate results the computer aided systems are used.

- **G.Wiselin Jiji, Jamshid Dehmeshki (2014)**, in this paper the author proposed different segmentation techniques in order to segment the brain image. In this paper they proposed an algorithm with scaled version via the wavelet analysis and Gaussian filter and this proposed algorithm is known as multi-resolution algorithm that extends the EM algorithm i.e. expectation maximization. By making the use of this algorithm they conclude that they get better segmentation results than that of the simple EM and they find that this algorithm is less sensitive to noise [2].

- **Babiya Nath Saha, Nilanjan Raya, Russel Greiner Albert Murtha, Hong Zhang**, In this paper the author indexed the database of a patient in accordance with their location, size , and some other characteristics of the brain tumor which is based on the magnetic resonance imaging. They detect or segment the tumor which is present within the image. In this paper they propose a fast, automated and approximate segmentation method. They take the input image from the patient study which consists of set of MR slices and the corresponding output is the subset of slices and these slices consists axis parallel boxes that circumscribe the tumor. In the research they search the most dissimilar regions between left and right halves in MR slice of the brain image. They apply Fast Bounding Box Technique for the segmentation of brain tumor [3].
- **Nandita Pradhan, A.K. Sinha(2010)**, In this paper they proposed a technique or develop feature vector by making the use of either wavelet parameter or by using

statistical parameter. They make the use of composite feature technique for the detection and the segmentation of normal tissues, fluid, pathological tissues, magnetic resonance MR images of brain. The main purpose of this paper is segmentation which is done by k- means clustering algorithm of cranial brain image into five segments which is based upon the statistical parameter and the wavelet energy function which gives the pixel value and reflects texture properties. For the detection of tumor they make the use of the block processing of image which is done by extracting feature from the small blocks which is the part of the tissues of the tumor, artificial neural network using back propagation algorithm [4].

- **Fan Yang, Wenjian Qin, Yaoqin Xie, Tiexiang Wen, Jia Gu**, In this paper, they proposed a method for US i.e. ultra-sound image segmentation of that is combined with NLTV (non local total variation) image denoising, shape and DRLSE (Distance Regularized Level Set Evolution). In this paper, from the NLTV image denoising they obtain an ultra-sound image denoising, after that in order to get binary image DRLSE is applied. In this the kidney and the background is represented by the black and white respectively. In order to increase the segmentation accuracy they use alignment models [5].

- **Gianni L. Vernazza, Sebastiano B. Serpico Silvana G.dellepiane(1987),** in this paper the author proposed a rule based system IBIS (Interpretation of Biomedical Images of the Slice type), starts from conventional processing can locate or recognize slices and locate slices automatically. The aspects of their system are: representation of knowledge, with 3-D and 2-D aspects for error recovery and conflict resolution anatomical description facilities at different backtracking levels; and a general system structure easy to extend to other application fields. For driven the model and data a strategy is applied which depends upon the progressive results and processing. This is the very basic paper they used for the segmentation [6].

- **Quintanilla-Dominguez, B.Ojeda-Magana,et. (2011),** in this paper the author proposed an approach to detect the Breast cancer. They detect the presence of micro calcification clusters which is considered an important indicator of breast cancer. They detect clusters in digitized mammograms which is based upon partitional clustering method and synergy of processing of image. They make the use of fuzzy or hard clustering algorithm in order to segment the images [7].

- **Saeid Fazli** Research Institute of Modern Biological Techniques University of Zanjan proposed a paper on,"A Novel Method for Automatic Segmentation of Brain Tumours in MRI Images.In this paperSaeid Fazli Research Institute of Modern Biological Techniques University of zanjan proposed a paper on," A Novel Method for Automatic Segmentation of Brain Tumors in MRI Images. In this paper we studied about brain tumor images, the segmentation of these images is very difficult task, if we do manually segmentation of these images, it will be more time consuming consequently, researchers presented a method in which they do the segmentation automatically. In this research they proposed a unsupervised segmentation for brain tumour.In this at first level the parts which are outside at skull and don't provide the information which have been removed and applied diffusion filter on MRI image to remove noise.FBB algorithm is also applied with bounding box which extract the features of that tumour. The database which is provided that is related to the number of patients. The results of this research is very helpful for easily recognize the size of brain tumour[8].

- **William A. Pearlman,et.al.**In this paper there are large number of medical image techniques that is mammography contrast sensitivity, spatial resolution. To reduce the cost of storage, data transmission time, which is helpful for reduce the digital data. for digital mammograms. we applied two region based compression. In these techniques after segmenting the region based discrete wavelet transform is performed. we have to compared about the new standards and original SPIHT by using irreversible and reversible filters, the proposed method provides the accurate resultsaza, Palestine ,proposed a paper on,"Multi-Resolution Analysis For Medical image Compression".In this paper we applied the efficient techniques for storage purpose and data transmission for improving the image compression.To achieve the maximum capacity for transmissions we applied the best optimal technique. This work proposes the wave-atom, curveletmethods and compared with number of techniques and take out the best technique for compression.Wave-atom is the best technique for image compression [9].

- **Sahil J Prajapat, et.al**Brain Tumour Detectionby Various Image Segmentation Techniques with Introduction to Non Negative Matrix Factorization.In digital image processing image segmentation is the most significantly approach with the help of this approach we segmented the number of images and extract the features of images by using morphological operations.MRI is one of the important researches in medical image.Thresholding techniques is used to detecting the tumour,and another approach is region growing which uses seed point,so we can easily detect the tumor.NMF (nonnegative matrix factorization) techniques areused for removing the dimensionality of data.An uninterruptable approach is applied for feature extraction and detection of tumor also.the results of NMF shows that no cancellation and all matrices contain non negative number of elements[10]

- **Sharif M. S. Al Sharif, Mohamed Deriche, et al (2013)** the study is carried out by using deformable geodesic active contour (GAC) method as it is one of the most popular techniques being used in object boundary detection of images. In this, work is done on improving the automatic GAC technique by utilizing and incorporating prior information that is being extracted from the image that is region of our interest. In addition to this, a new stopping function is proposed to speed up the convergence and for improving the accuracy. This technique was applied to both synthetic as well as real medical images. When compared with the previous work the results illustrated both an improvement of more than 40 % in convergence speed with an excellent accuracy.[11]
- **Rema M. and Madhu S. Nair (2013)** Study showed that purpose identification of human intestinal parasites by using microscopy images of fecal sample is an important and time consuming process in the diagnosis of intestinal parasitosis. The automatic image processing technique can be applied to segment and identify the parasite, but the process becomes challenging one because of the presence of fecal impurities. This paper presents a framework for segmentation of bright field microscopy images of fecal sample

that contain both impurities and parasites. In this the framework of morphological opening, thresholding, and Active Contour Model (ACM) is used. Contour is evolved using Localized Mean- Separation based Active Contour Model (LMS-ACM) and initialized using thresholding and morphological opening. Results showed that this framework is fast, simple, and yields good results even when the parasites are overlapped with impurities. Method accuracy is being tested by comparing the results with manually segmented images and it was concluded that as in the identification process accurate segmentation of the objects is the first and important step, this work is a capable approach towards the automatic diagnosis of human intestinal parasitosis [13].

- **N.Hemalatha, 2 V.Revathi, et al (2014)** this paper presents the study on automatic identification of brain tumor location and its size in Brain MR Images. The input of this method is study on patient which consists of a set of MR images or slices and the output of this method is done using the set of the slices or an image having tumor that contains the axis parallel boxing around the tumor with the exact location of name and the size of tumor. This proposed method is based on the detection that containing the most dissimilar region between the left and the right side of the brain in an axial location. The detection process is employed by using the novel based algorithm called as Bhattacharya coefficient which is used to provide gray level intensity histograms. This method shows efficient results in complex situation. [

Chapter -3

Present Work

3.1 Problem Formulation

In the previous chapter, we review the different paper based on the different detection and segmentation techniques to understand the concepts in depth. The detection and segmentation of the MRI image is important to extract the important information from the biomedical image, it is not an easy task. It is quite complex and difficult. For the detection of brain tumour the conventional image processing techniques are not applied straight. There exists a huge variation of signal of same tissues from person to person. It has inherent noise and other imaging parameters. The process of extracting brain tumour through the MRI images or CT- scan images is a challenging process. We can't directly perform edge based segmentation as there is not clear intensities of white and gray. Although, improving imaging techniques could give good results of segmentation. Medical imaging is relatively difficult process as there are undesired properties like low signal to noise ratio and multiple discontinuities. There exist a number of biomedical imaging modalities like X-ray imaging, CT-scan, fluoroscopy etc. but presently the best approach or choice to detect the brain image tumour is MRI imaging, but how to interpret MRI is totally based upon the radiologist opinion. The detection and segmentation of brain tumour manually consumes more time and a very difficult task. Hence we require an efficient and automated detection and segmentation method which gives accurate results.

3.2 Objective

On the basis of the literature survey the objective of the research is given below.

- To propose a novel technique for detection of tumor.
- Analyze and apply the noise removal filter.
- Analyze and apply Haar transform.
- Apply Fast Bounding Box Algorithm to detect the tumor part.

- Extract or segment the tumor part.
- Assign color to extracted tumor part.
- Fix the colored part on the on the final image.

3.3 Methodology

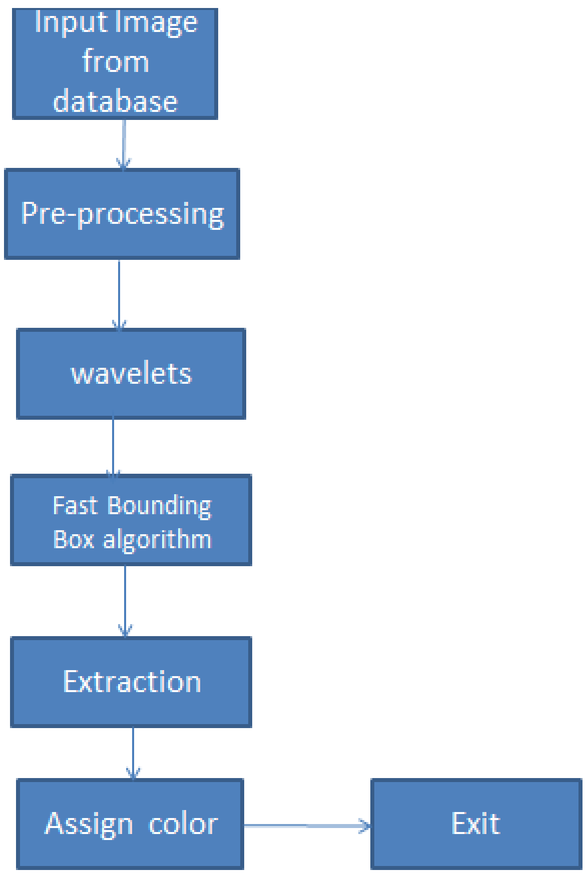

Figure5, Work flow of methodology

3.3.1 Image acquisition

Input for tumor detection and extraction is from database of MRI or CT scan.

3.3.2 Pre-processing

In pre-processing following steps are followed so that the image obtained after pre-processing is free from input noise such that it enhances the detection capability.

Block diagram of pre-processing

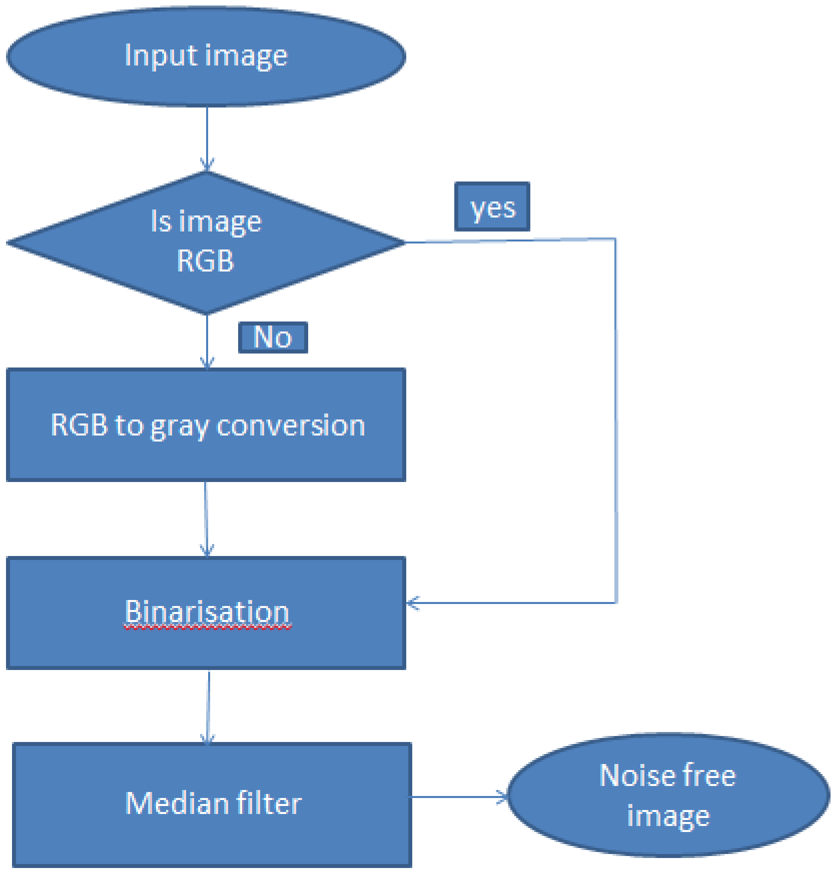

Figure6, Flow diagram of pre-processing

In pre-processing number of operations are performed in series on the input scanned image. This process is done such that acquired image after pre-processing is suitable for segmentation.

3.3.2.1 Conversion from RGB to Gray

The scanned input image can be in RGB format as we are using different image formats. In order to process these images first the scanned image should be converted to gray. For a gray scale image the range of pixel is from 0-255 which tells that how dark or light the pixel is.

3.3.2.2 Binarization

All the further processing will be done on binary image hence conversion is required from gray to binary .In binary image the pixel value can be 0 or 1 all pixels which are greater than threshold are made to 1 and rest are made to 0.

3.3.3 Wavelets

Wavelets are applied for compression and low frequency components are taken and further processed in next step.

LL frequency components are extracted after this.

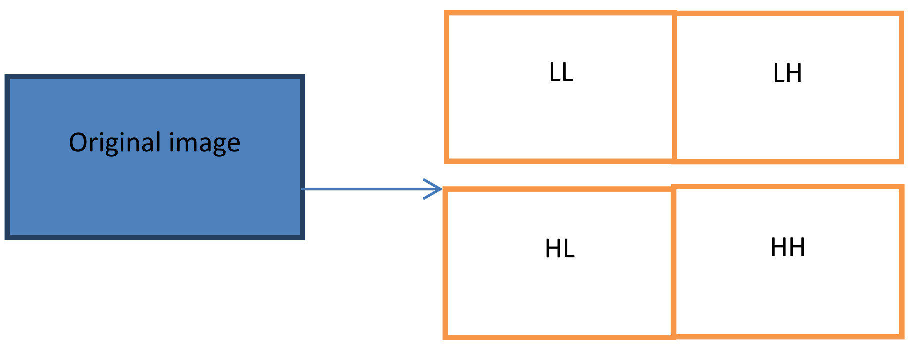

Figure 7, Wavelets

3.3.4 Flow chart of Fast Bounding Box Algorithm

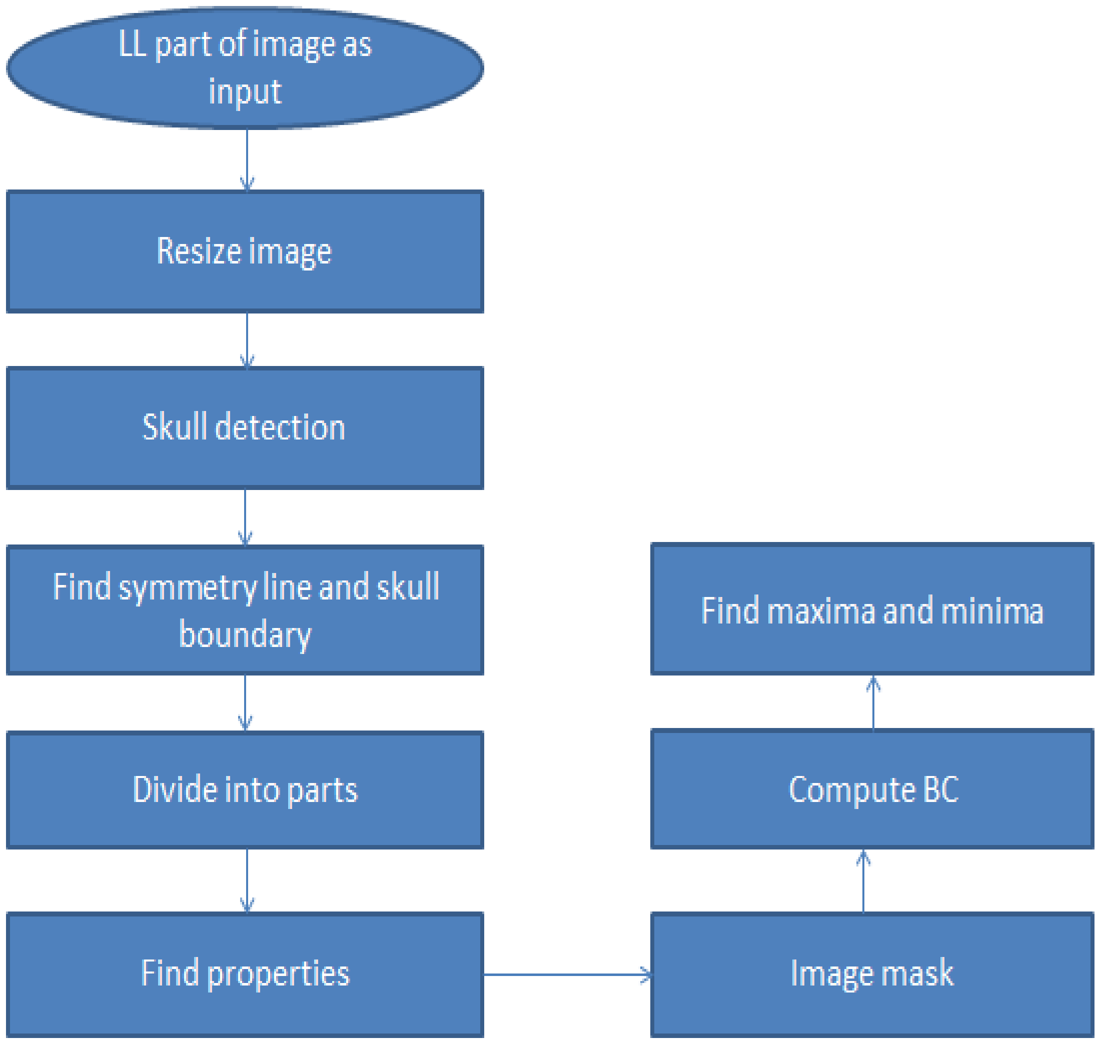

Figure 8, Flow diagram of FBB

- From the output of the wavelet transform the LL part of the image is taken and then resize. Then we apply fast bounding box algorithm on the resized image.
- The next step is the detection of skull, in order to detect the skull we fill holes and calculate the maximum number of connected components by making first row, last row, first column, last column zero.

- As we know the human brain has the symmetry property, by making the use of symmetry property we find the abnormality present in the brain by dividing the brain into two parts and the difference is made by comparing the intensities these two parts.
- The first part that is the left side of the image is considered as the original image and taken as the test image, and the second part is the right side of the image which is treated as the reference image.
- The next step is the scanning of the image that is horizontal scanning and vertical scanning. For the detection of the change in region we compute the Bhattacharaya coefficients. Bhattacharya coefficient use score function for the each scanning, horizontal scanning or the vertical scanning.
- Firstly vertical score function is used for the vertical scanning, and secondly horizontal score function is used for the horizontal scanning
- As score function has the property or the nature of decreasing-increasing and again increasing which makes some segment and for vertical scanning meets at some point and similarly for the horizontal scanning, thus horizontal sweep and vertical sweep forms the upper bound or lower bound of the change of region.
- When the change of region is detected a rectangle axis-parallel is formed around the tumor part.
- Then this tumor part is extracted which is inside the rectangle from the image.
- We assign color to the tumor part, and again this colored part is fixed on the image.

Chapter 4

Results and Discussions

In the previous chapter, we have seen the methodology of proposed work in this chapter we will see the results step wise**.**

4.1 Results for first Image

Menu Barit is used for the users input

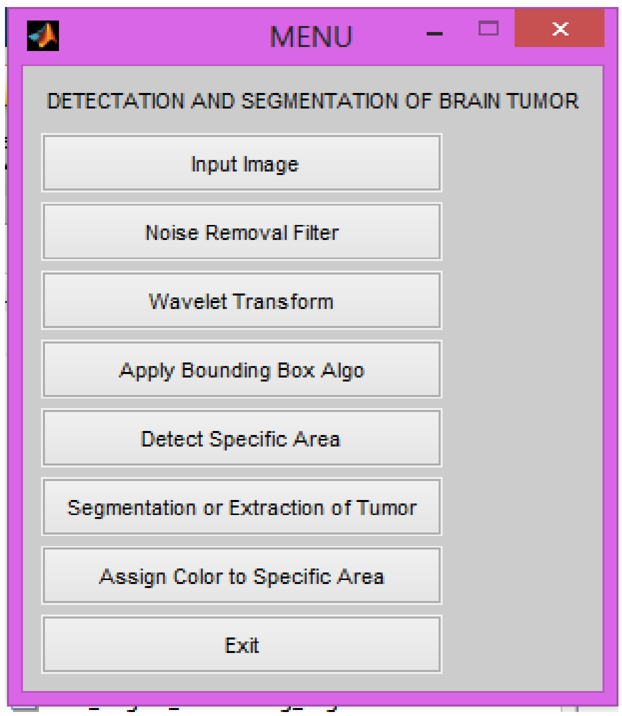

Figure9, Menu Bar

1. This is one of the input MR image from our database on which we analyze the results. This MR image is taken from google search.

Figure10,Input image

2. Apply the median filter to remove the noise present in the input image which results in an enhanced image to analyze the results more efficiently.

Figure 11, Noise filtered image

3. Apply the Haar wavelet on the filtered image for compression since medical images requires more memory space due to which processing speed decreases so we apply Haar wavelet to overcome this problem.

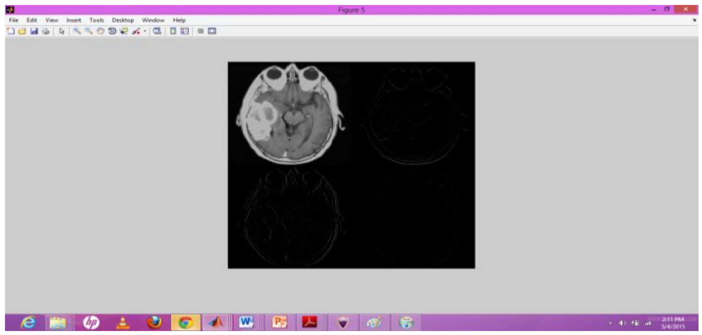

Figure12,Haar transform

4. We extract the LL part of the compressed image and resized this compressed image into 256×256.

Figure 13,Resized image

6. Detect the skull of the resized image by finding the connected components than find pixel value of each connected components and at last extract the component which has maximum pixel value. In this we detect the skull of the image.

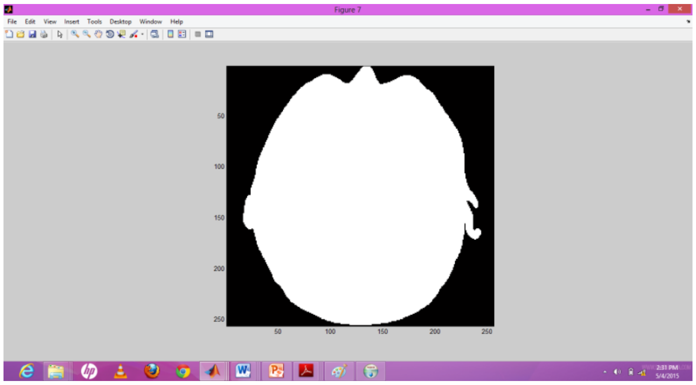

Figure14, Skull detection

7. In this we divide the image in two parts. Symmetry line and the skull boundary are obtained.

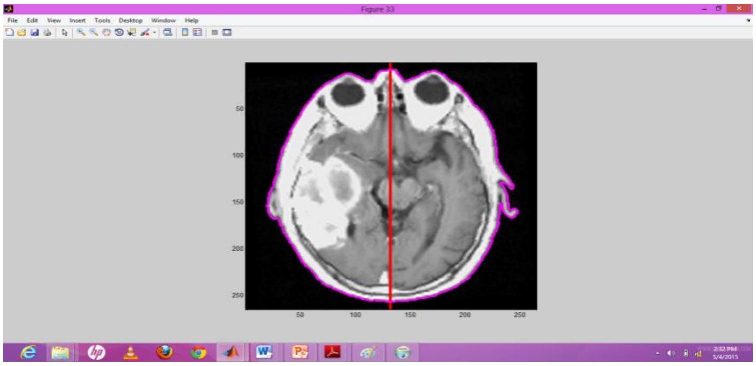

Figure15, Skull boundary and line of symmetry of brain image

8. Image mask

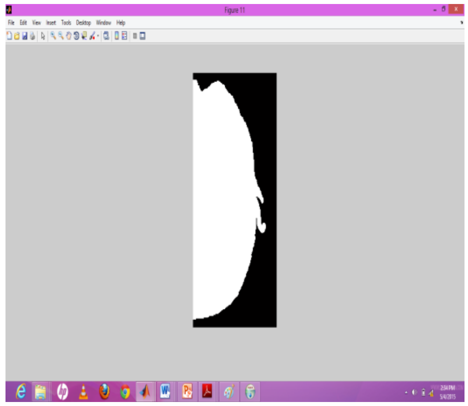

Figure 16(a), Image mask

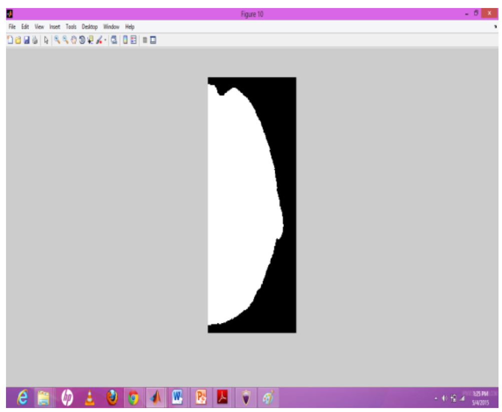

Figure16(b), Image mask

9. Upper bound and lower bounds is obtained by using vertical score function for the vertical scanning and horizontal score function for horizontal scanning. Thus, change of region is obtained and a rectangle axis parallel is obtained around the tumor part.

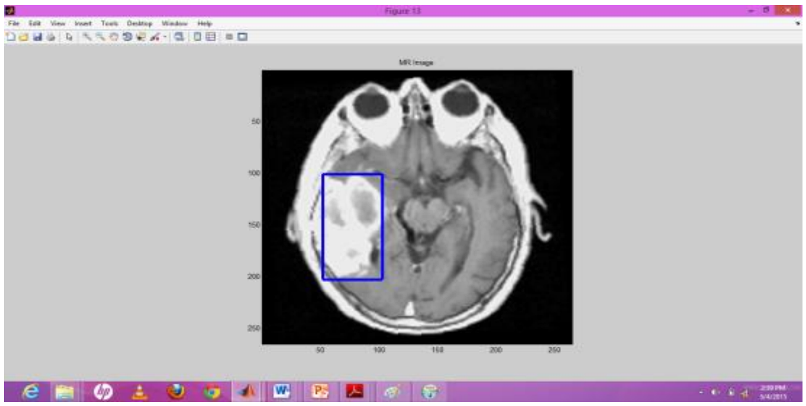

Figure 17,Result of FBB

10. This is the extracted part of the MR image which contains the tumor which is circumscribe by the rectangle axis parallel.

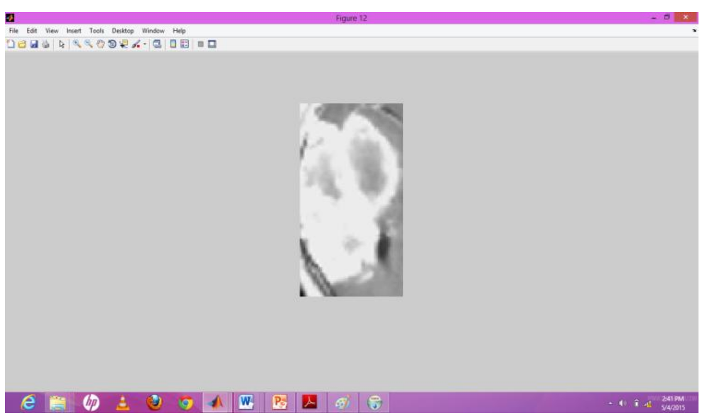

Figure 18, Extracted tumor part

11.Then we assign the colour to the extracted part.

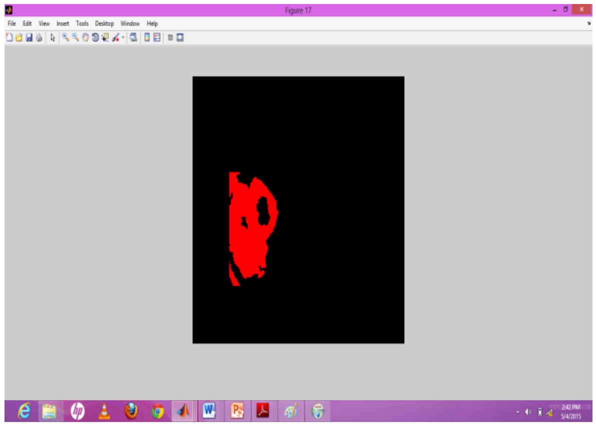

Figure 19,Colored tumor part

12.Resultant image

Figure 20,Resultant image

4.2 Results for the second image

1. This is the second MR input image from our database on which we analyze the results. This MR image is taken from google search.

Figure21, Input image

2. Apply the median filter to remove the noise present in the input image which results in an enhanced image to analyze the results more efficiently.

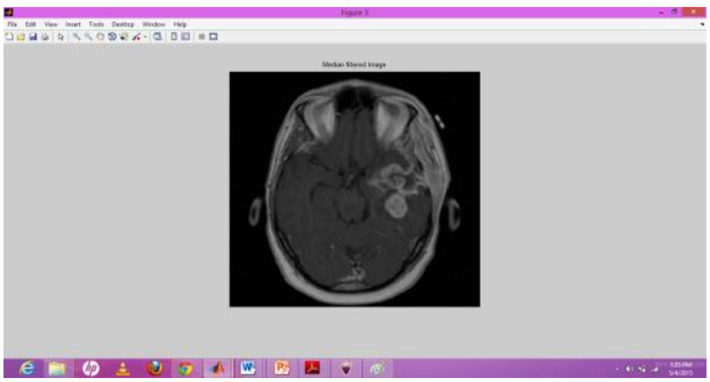

Figure22, Median filtered image

3. Apply the Haar wavelet on the filtered image for compression since medical images requires more memory space due to which processing speed decreases so we apply Haar wavelet to overcome this problem.

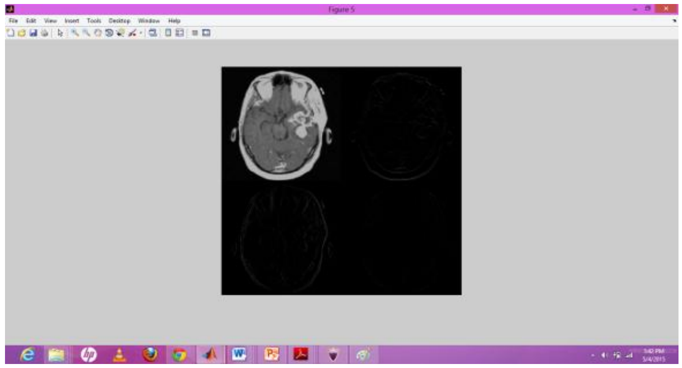

Figure23, Haar transform

4. We extract the LL part of the compressed image and resized this compressed image into 256×256.

Figure24, Resized image

5. Detect the skull of the resized image by finding the connected components than find pixel value of each connected components and at last extract the component which has maximum pixel value. In this we detect the skull of the image.

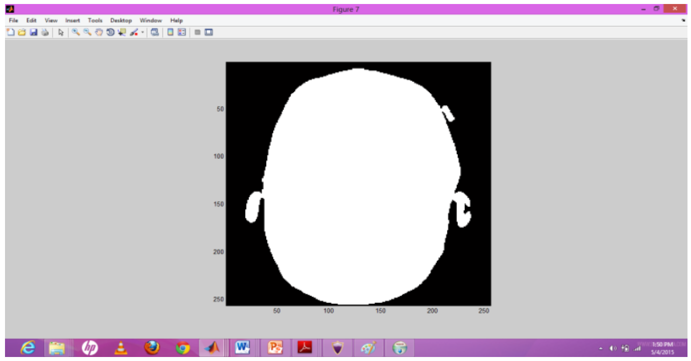

Figure25, Skull detection

6. In this we divide the image in two parts. Symmetry line and the skull boundary are obtained.

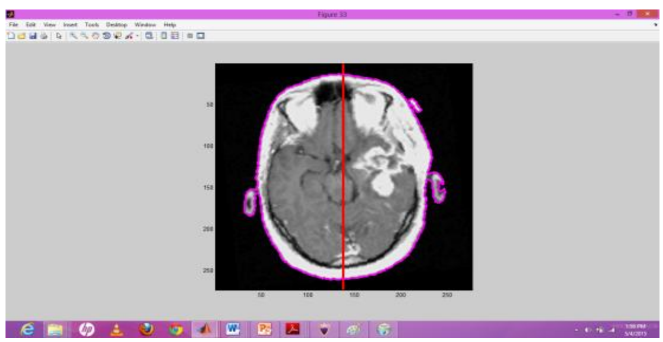

Figure26, Skull boundary and symmetry line of brain image

7. Upper bound and lower bounds is obtained by using vertical score function for the vertical scanning and horizontal score function for horizontal scanning. Thus, change of region is obtained and a rectangle axis parallel is obtained around the tumor p

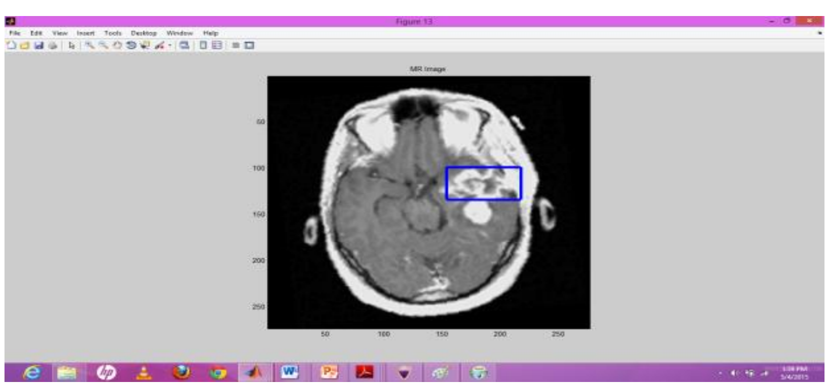

Figure27, Result of FBB

8. This is the extracted part of the MR image which contains the tumor which is circumscribe by the rectangle axis parallel.

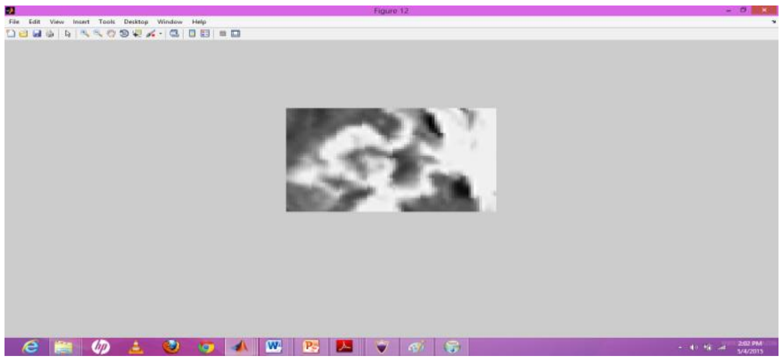

Figure28, Extracted tumor part

9. Then we assign the colour to the extracted part.

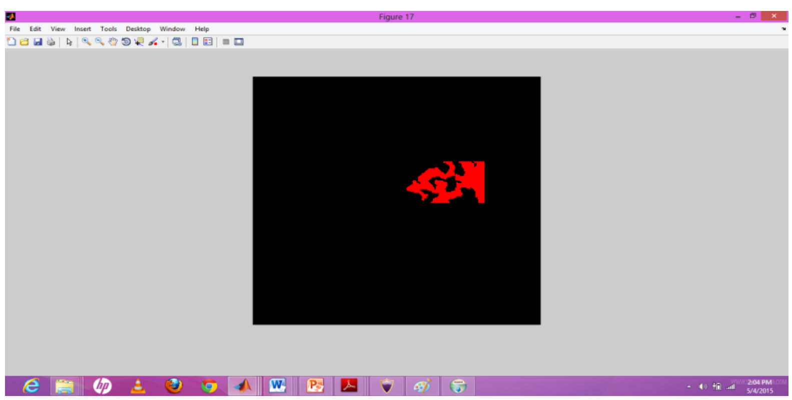

Figure 29, Colored tumour part

10. Resultant image

Figure30, Resultant image

4.3 Results for third image

1. This is the third MR input image from our database on which we analyze the results. This MR image is taken from google search.

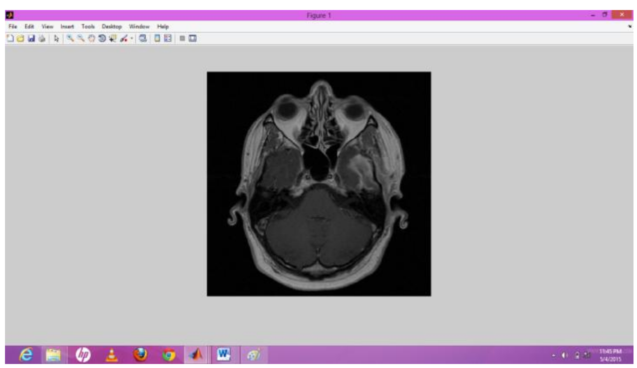

Figure31, Input image

2. Apply the median filter to remove the noise present in the input image which results in an enhanced image to analyze the results more efficiently.

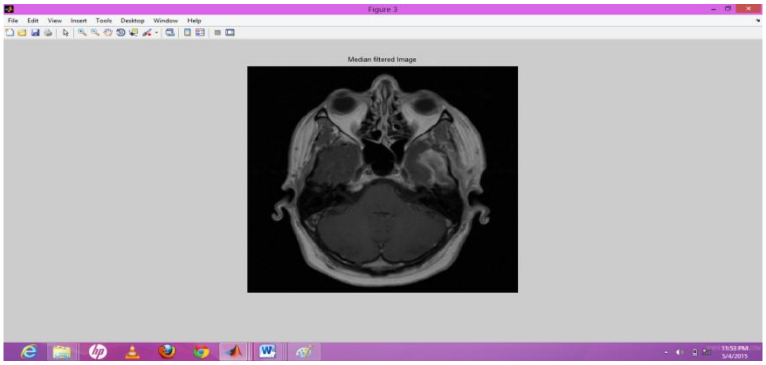

Figure32, Median filtered image

3. Apply the Haar wavelet on the filtered image for compression since medical images requires more memory space due to which processing speed decreases so we apply Haar wavelet to overcome this problem.

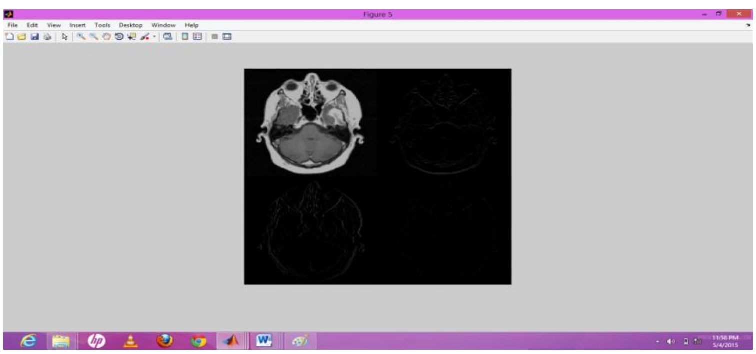

Figure33, Haar transform

4. We extract the LL part of the compressed image and resized this compressed image into 256×256.

Figure 34, Resized image

5. Detect the skull of the resized image by finding the connected components than find pixel value of each connected components and at last extract the component which has maximum pixel value. In this we detect the skull of the image.

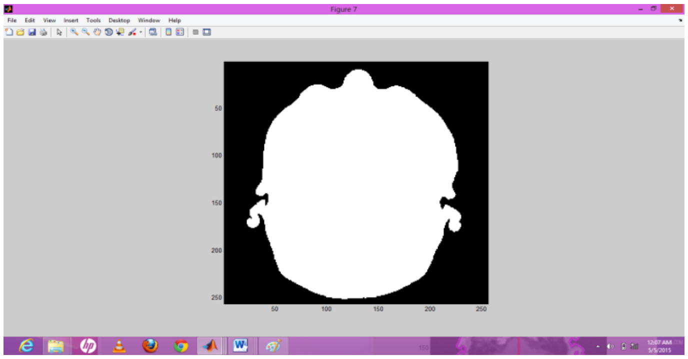

Figure35, Skull detection

6. In this we divide the image in two parts. Symmetry line and the skull boundary are obtained.

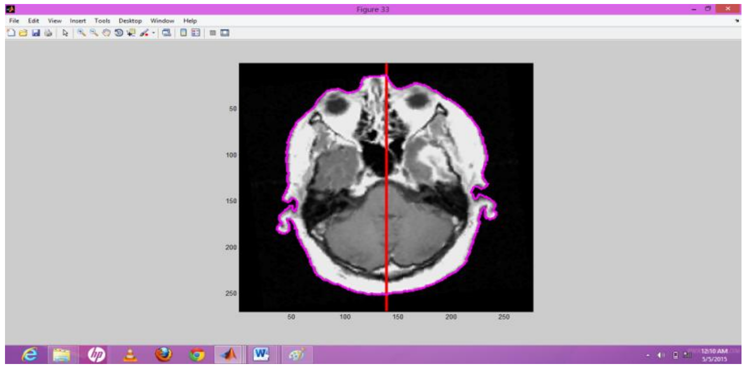

Figure36, Skull boundary and symmetry line of brain image

7. Upper bound and lower bounds is obtained by using vertical score function for the vertical scanning and horizontal score function for horizontal scanning. Thus, change of region is obtained and a rectangle axis parallel is obtained around the tumor part.

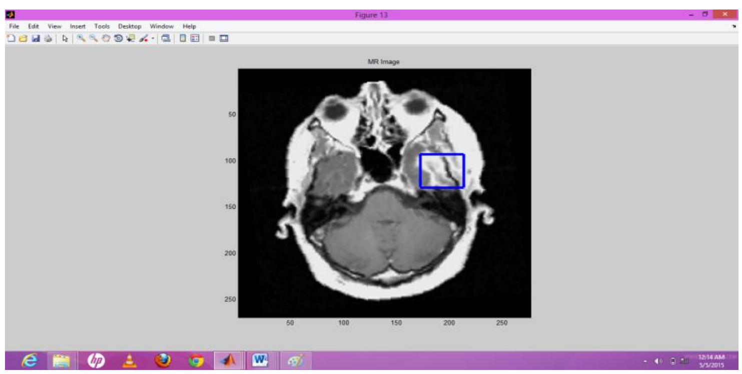

Figure37, Result of FBB

8. This is the extracted part of the MR image which contains the tumor which is circumscribe by the rectangle axis parallel.

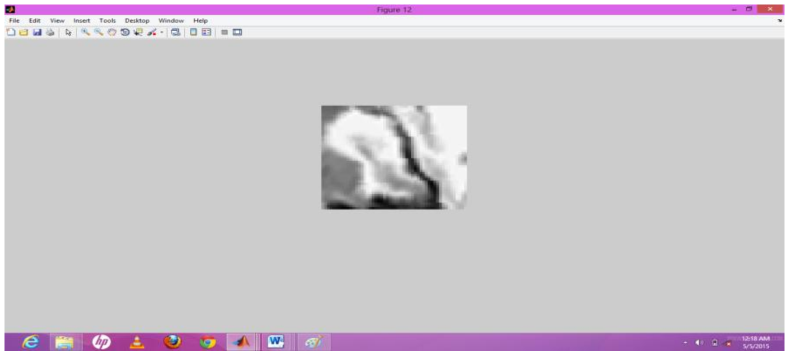

Figure 38, Extracted tumor part

9. Then we assign the colour to the extracted part.

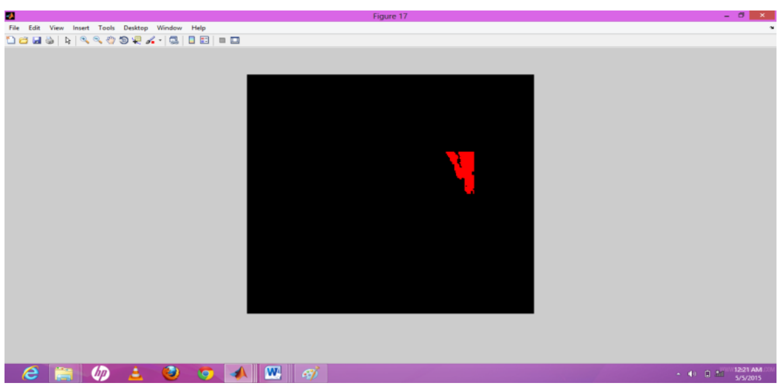

Figure 39, Coloured tumor part

10. Resultant image

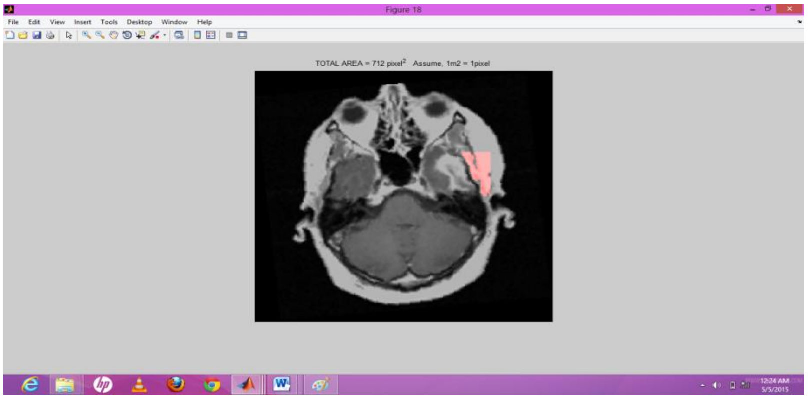

Figure40, Resultant image

4.4 Comparison Between The Area Calculated of Tumor using Threshold, FBB, method And Manually.

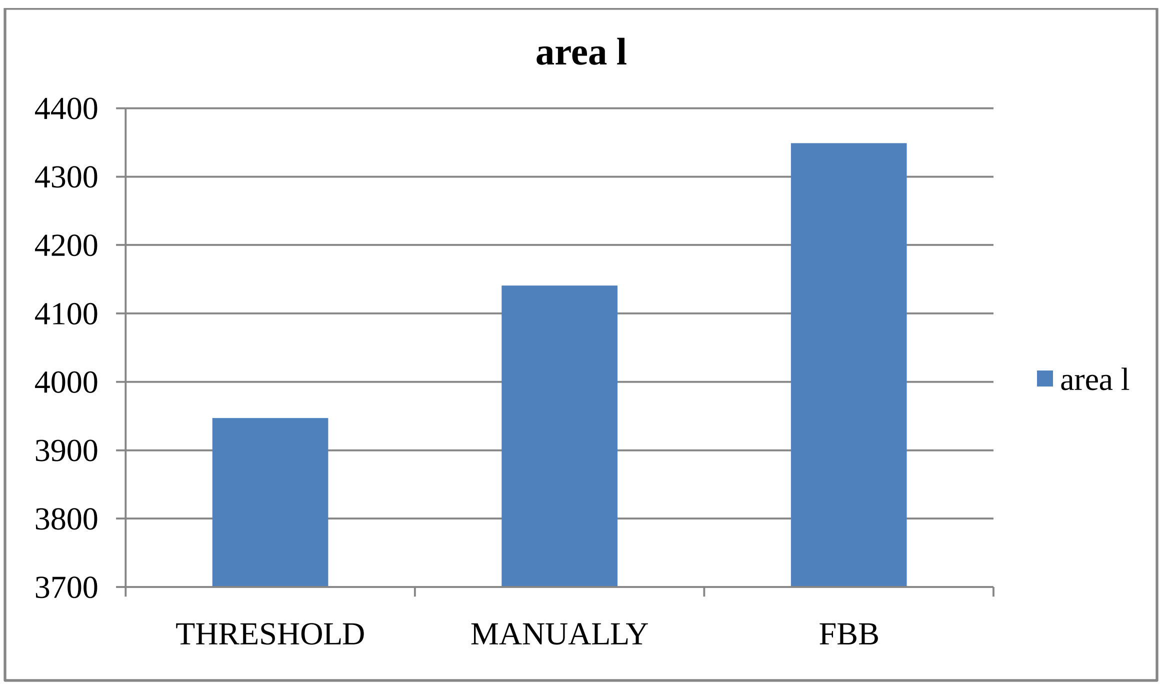

Figure41, Comparison of area by using three methods

Chapter 5

Conclusion and Future Scope of Study

Conclusion

In this we detect the tumor from MR images by using fast bounding box algorithm. In this first we enhanced the image to remove the noise with the help of median filter so that tumor can be detected more clearly. We use the Haar wavelet for compression so that it takes less memory space due to which this algorithm becomes fast. In this thesis, with the help of fast bounding box algorithm we can detect the exact position of tumor. There are many cases in which detection of position of tumor is carried out, we could detect only half part of the tumor due to which there is a chance of losing the important information which may create problems in diagonizing the patients. So we used this algorithm to detect the exact position of tumour. There is one more method used in which we coloured the tumor part due to this we get the highlighted part of tumor. It helps the doctors to analyse the tumor image more accurately. The use of fast bounding box algorithm leads to more accurate calculation of area of tumor.

Future Scope

This thesis could be more efficient and accurate if we use more enhancement techniques available in image processing. Due to this we could detect the tumour more accurate. Since the use fast bounding box algorithm helped in finding the exact position of tumor, we can further improve this algorithm so that it could detect the hidden positions of tumor also. In this way this work could be better.

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Abbreviations

Appendix

MRI	Magnetic Resonance Imaging
FBB	Fast Bounding Box
IARC	International Agency for Research on Cancer
CT Images	International Agency for Research on Cancer
CNS	Central Nervous System
WHO	World Health Organization
CT	Computed Tomography
PET	Positron Emission Tomography
SPECT	Single Photon Emission Tomography
RGB	Red Green and Blue Colour Space