BRAIN TUMOR DETECTION USING IMAGE PROCESSING TECHNIQUE FROM MRI IMAGES BASED ON OTSU ALGORITHM

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

Brain Tumor is an aggregation of abnormal cells within the tissues of the brain. One out of twenty people with brain tumor loses their life due to the failed detection of the tumor. Well trained physicians can spot these tumors through series examinations and MRI scans, however some artifacts in the scan mislead them and end up in misreading the scan result. A pathologist looks at the tissue cells under a microscope to check for presence of abnormality. Though biopsy will show the presence of tumor and its pathology, when doctors go for surgery, they must know the tumor extent and the exact location of tumor in the brain. Which can be found by taking MRI scan of the patient as MRI doesn't involve the use of harmful radiations when compared to CT scan. The main objective of the project is to detect the brain tumors in precise despite the artifacts. The MRI (Magnetic Resonance Imaging) scan images of various patients at various stages are made to use for the detection of tumors. In order to detect the suspicious region or tumors in precise a new approach inspired by threshold segmentation and morphological operation has been used. These techniques involve different image processing methodologies such as noise removal, filtering, segmentation, bounding box, tumor alone, tumor outline and detection. Detection and extraction of the tumor from MRI scan images of the brain is done by using MATLAB software. Extraction of brain tumor can be accomplished successfully by performing these operations.

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ACRONYMS	ABBREVIATION
AC	Active Contour
CT	Computed Tomography
GUI	Graphical User Interface
MAT LAB	Matrix Laboratory
RAM	Random Access Memory
ROM	Read Only Memory
RGB	Red Blue Green
MRI	Magnetic Resonance Imaging
UI	User Interface

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION:

Brain tumor is abnormal mass of tissues in which cells grow and multiply uncontrollably seemingly unchecked by the mechanisms that control normal cells. One out of twenty people with brain tumor loses their life due to the failed detection of the tumor. Well trained physicians can spot these tumors through series examinations and MRI scans, however some artifacts in the scan mislead them and end up in misreading the scan result.

The main objective of the project is to detect the brain tumors in precise despite the artifacts. It is a most complicated in our body. Our brain is enclosed by skull which is very rigid. Symptoms are frequent headaches and migraines. A primary brain tumor originates in our brain. Many primary brain tumors are benign. A secondary brain tumor, which a metastatic brain tumor occurs when cancer cells spread to our brain from another organ, such as lung or breast. Brain tumors are frequently referred to as cancerous also termed as malignant or noncancerous termed as benign cells in the brain. This paper aims to develop and evaluate a technique to process Magnetic Resonance Images (MRI) for brain tumor by using OTSU threshold segmentation.

It is used to perform automatic image thresholding. The algorithm returns a single intensity. Threshold is a separate into two classes, foreground and background. We convert an image from grayscale into a binary image. The processes of identifying brain tumors through MRI images can be different categorized are pre-processing, image segmentation and image classification. The detected brain tumor will be indicated in a brightest colour. This detection and extraction process is done by using the MATLAB tool.

1.2 OVERVIEW:

A brain tumor is a collection, or mass, of abnormal cells in your brain. Your skull, which encloses your brain, is very rigid. Any growth inside such a restricted space can cause problems. Brain tumors can be cancerous (malignant) or noncancerous (benign). When benign or malignant tumors grow, they can cause the pressure inside your skull to increase. This can cause brain damage, and it can be life-threatening. Brain tumors are categorized as primary or secondary. A primary brain tumor originates in your brain. Many primary brain tumors are benign. A secondary brain tumor, also known as a metastatic brain tumor, occurs when cancer cells spread to your brain from another organ, such as your lung or breast.

Though there are many medical imaging techniques, Magnetic Resonance Imaging is the best imaging technique due to no radiation exposure hence no side effects and it is highly accurate in detecting abnormalities in the internal structures of human organs. The structure of the brain is complex and its tissue segmentation is very crucial to visualize and quantify various brain disorders. This fact makes MRI more popular and enables effective medical imaging techniques among the rest. It is an advanced medical imaging technique used to produce high quality images of the body parts. From these high-resolution images, we can derive detailed anatomical information to examine human brain development and discover abnormalities.

Noise is the main parameter that affects the medical image segmentation. Images can be demised by using various spatial filters like the low-pass, median, adaptive filter, and so forth. But these filters blur the sharp lines or edges, may respect the edges but the resolution gets decreased by abolishing fine details, and may generate artifacts. To overcome the drawbacks of filters proposed anisotropic diffusion filter which has the properties of sharpening the discontinuities, preserving detailed structures and object boundaries so loss information is minimized, and removing noise in homogeneous regions.

This paper aims to develop and evaluate a technique to process Magnetic Resonance Images (MRI) for brain tumor by using OTSU threshold segmentation. Firstly, we use a pre-processing to enhance image contrast and quality by intensity adjustment. Secondly, the improved image is segmented using the multi-Otsu method .It is used to perform automatic image thresholding. The algorithm returns a single intensity. Threshold is a separate into two classes, foreground and background. We convert an image from grayscale into a binary image. Finally, a morphological reconstruction was performed with the appropriate structuring element parameter on the segmented image to determine the tumor. The processes of identifying brain tumors through MRI images can be different categorized are pre-processing, image segmentation and image classification.

1.3 AIM AND OBJECTIVE

This paper aims to develop and evaluate a technique to process Magnetic Resonance Images (MRI) for brain tumor by using OTSU threshold segmentation. Firstly, we use a pre-processing to enhance image contrast and quality by intensity adjustment. Secondly, the improved image is segmented using the multi-Otsu method. It is used to perform automatic image thresholding. The algorithm returns a single intensity. Threshold is a separate into two classes, foreground and background. We convert an image from grayscale into a binary image. Finally, a morphological reconstruction was performed with the appropriate structuring element parameter on the segmented image to determine the tumor. The processes of identifying brain tumors through MRI images can be different categorized are pre-processing, image segmentation and image classification. The Brain tumor is an intracranial solid neoplasm. The Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably seemingly unchecked mechanisms control normal cells. The main task of the doctors is to be detecting the brain tumor which is a time consuming for which they feel to burden. The optimal solution for this problem is the use of image segmentation. Image segmentation technique is problem dependent has been considered. So in our project, we made an attempt to pick up already segmented images and further smoothening the image using various types of filters and analyze their effectiveness. To detect the brain tumor in brain magnetic resonance images (MRI) with high efficiency.

To overcome the difficulties in diagnose the tumor cells at early stage. To implement a proper technique based on OTSU thresholding method to classify tumor affected region and unaffected region. The main aim of our project is design to framework for automatic detection of the tumor to obtain more accuracy from the imaging dataset which play a vital role of diagnosis of tumor by using various image processing algorithm. The objective of this work is bringing some useful information in simpler form in front of the users, especially for the medical staff treating the patient. The processes of identifying brain tumors through MRI images can be different categorized are pre-processing, image segmentation and image classification. It is done by using MATLAB tool.

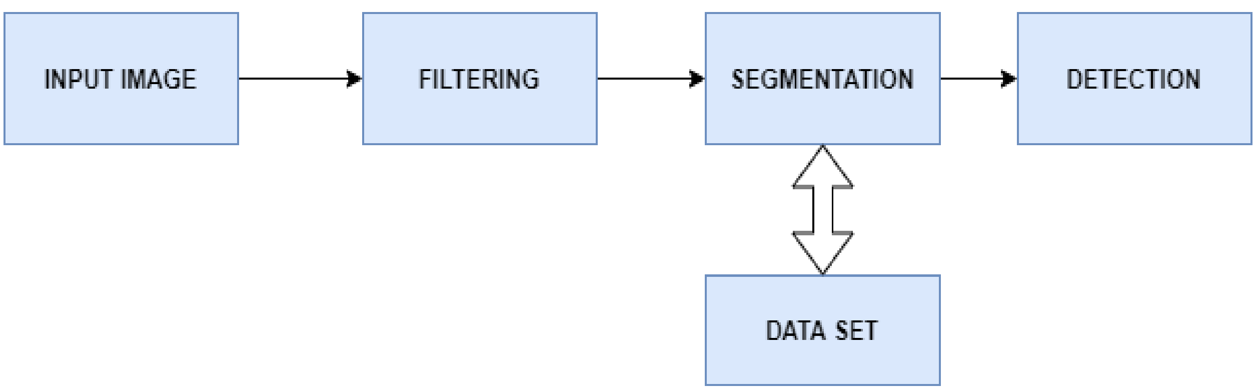


FIG 1.4: BLOCK DIAGRAM OF BRAIN TUMOR DETECTION

This block diagram represents the steps and procedure of brain tumor detection.

1.4 EFFECT OF BRAIN TUMOR:

People with brain tumors will experience them no matter if the tumor is benign (not cancerous) or cancerous. Primary and secondary brain tumors present with similar symptoms, depending on the location, size, and rate of growth of the tumor. For example, larger tumors in the frontal lobe can cause changes in the ability to think. However, a smaller tumor in an area such as Warnock’s area (small area responsible for language comprehension) can result in a greater loss of function.

Headaches as a result of raised intracranial pressure can be an early symptom of brain cancer. However, isolated headache without other symptoms is rarer, and other symptoms often occur before headaches become common. Certain warning signs for headache exist which make it more likely to be associated with brain cancer. These are as defined by the American Academy of Neurology: "abnormal neurological examination, headache worsened by Valhalla maneuver, headache causing awakening from sleep, new headache in the older population, progressively worsening headache, atypical headache features, or patients who do not fulfill the strict definition of migraine".

Location specific symptoms are the brain is divided into 4 lobes and each lobe or area has its own function. A tumor in any of these lobes may affect the area's performance. The location of the tumor is often linked to the symptoms experienced but each person may experience something different.

Frontal lobe is tumors may contribute to poor reasoning, inappropriate social behavior, personality changes, poor planning, lower inhibition, and decreased production of speech (Boca’s area).

Temporal lobe is tumors in this lobe may contribute to poor memory; loss of hearing, difficulty in language comprehension (Warnock’s area).Parietal lobe is tumors here may result in poor interpretation of languages, decreased sense of touch and pain, and poor spatial and visual perception. Occipital lobe is damage to this lobe may result in poor or loss of vision. Cerebellum is tumors in this area may cause poor balance, muscle movement, and posture. Brain stem is tumors on this can affect blood pressure, swallowing, and heartbeat.

Despite the personality and behavior changes that occur in people with brain tumors, little research on such changes has been done. A person's personality may be altered due to the tumor damaging lobes of the brain. Since the frontal, temporal, and parietal lobes control inhibition, emotions, mood, judgment, reasoning, and behavior, a primary or secondary tumor in that region can cause inappropriate social behavior, temper tantrums, laughing at things which merit no laughter, and even psychological symptoms such as depression and anxiety. Personality changes can have damaging effects such as unemployment, unstable relationships, and a lack of control.

A tumor in any of these lobes may affect the area's performance. The location of the tumor is often linked to the symptoms experienced but each person may experience something different.

The isolated headache without other symptoms is rarer, and other symptoms often occur before headaches become common. Certain warning signs for headache exist which make it more likely to be associated with brain cancer.

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE REVIEW

Pankag et al., (2015) in their research mathematical morphology plays a vital role by providing a systematic approach to analyze the geometric characteristics of images and signals. They have applied this approach to many applications such as object segmentation, edge detection, noise suppression and so on. The MATLAB simulation is carried on different brain images and tumor is detected using the method for image segmentation and optimal global thresholding. The brain tumor detection is a great help for the physicians and a boon for the medical imaging and industries working on the production of CT scan and MRI imaging.

Shahriar et al., (2019) this study focuses on automated approach that enhances the initial stage to minimize the variation in grey scale color. For better segmentation unwanted noises are removed using filter operation. The experimental results showed that the proposed approach was able to perform better results compared to existing available approaches in terms of accuracy while maintaining the pathology experts' acceptable accuracy rate**.**

mohamed shakeel et al., (2018) in this research the analysis of brain tumors without human intervention is considered a significant area of research because the extracted brain images need to be optimized using a segmentation algorithm that is highly resilient to noise and cluster size sensitivity problems and automatically detects the region of interest (ROI). Further data imbalances due to improper edge matching in the abnormal region is sampled by matching the edge coordinates and sensitivity, and the selectivity parameters are measured using the machine learning algorithm.

Kavitha et al., (2012) approaches an effective modified region technique for brain tumor detection. They have stated that this modified region growing includes orientation constraints in addition to normal intensity constraints. For validating the effectiveness of the modified region growing, the quantity rate parameter has been considered. For the evaluation of the proposed technique of tumor detection, the sensitivity, specificity and accuracy values were used. A comparative study has been carried out between normal and modified region growing and proved that modified region growing achieves better results.

Harmandeep Kaur et al., (2016) this research paper proposes a method called Image segmentation is a way to analyze the images and to extract objects out of it. Many researches had been done in this field but still the field is a challenge for the scholars. It is widely used in diagnosis of tumor patient by detecting the tumor in brain using segmentation. Brain tumor segmentation is based on separating the tumor issues from normal brain tissues so as to find the area of tumor. In this paper a technique of segmentation for finding the area of tumor has been represented. A significant area of research because the extracted brain images needs to be optimized using a segmentation algorithm that is highly resilient to noise and cluster size sensitivity problems and automatically detects the region of interest (ROI).

Mohammed et al., (2020) this research experiments the effectiveness of geo metrical and fusing texture in MRI for classification of tumor. Fast non local mean method has been used to enhance the tumor region and Otsu has been used for segmentation. Multiple features are acquired and merged into single dimensional vector for detection and found the features fusion method had better result than individual features.

Astina minz, et al., (2017) an effective automatic classification method for brain MRI on the dataset of 50 MRI images is projected using the machine learning algorithm. The proposed system consists of three parts such as Preprocessing, Feature extraction and Classification. Preprocessing has removed noise in the raw data, it transform RGB image into grayscale, median filter and thresholding segmentation is applied. For feature extraction by using GLCM technique used It gives 89.90% accuracy and result in normal brain or in Malignant or Benign type of tumor. In future work, we can work of quadratic and polynomial kernel function. The accuracy of the system will be increased by increasing training database images. Also the system can be implementing for different types of classes like Glioma and Meningioma.

Mukambika et., (2017) Methodology in which Image processing is processed through the Preprocessing, Segmentation, Feature extraction Classification stages from the dataset of 41 MRI images. In preprocessing, Morphology technique using double thresholding is applied to remove the skull out of the MRI brain images. The present work presents the comparison study of two techniques used for tumor detection of MRI images. One is based on the Level set method that uses the non parametric deformable models with active contour to segment the brain tumor from the MRI brain images. The other one is the K-means segmentation algorithm. After the segmentation decision making is performed in two stages: Feature extraction using Discrete Wavelet Transform and Gray Level Co- occurrence Matrix, and classification using the Support Vector Machine. Dataset of MRI brain tumor images includes T2 weighted 17 benign and 24 malignant tumor images of different patients. SVM with Level Set and K-Means segmentation classify image into normal brain, benign or Malignant tumor with 94.12% and 82.35% accuracy respectively. Level Set method gives better results than kmeans segmentations.

Rasel Ahmmed, et al.,(2017) proposed method which include stages like image pre-processing, segmentation, feature extraction, SVM classification and tumor stage classification using Artificial Neural Network(ANN). In pre-processing three contrast enhancement techniques like adjusted, adaptive threshold and histogram imaging using both weiner2 and median2 filter is applied. In First order statistic features and in Second order region property based statistic features are derived. Then SVM classify brain MRI image into normal or tumor brain. Brain Tumor stage is classified by ANN classifier. The number of the used data for each MRI image of normal brain. Malignant tumor, and benign tumor is obtained from 39 images where 3 normal, 9 benign, 17 malignant I, 6 malignant II, 3 malignant III, and 1 and malignant IV stage tumor brain MRI images. The accuracy of proposed method is 95.4%,

K. Sudharani, et al., (2015) Proposed Methodology include methods like Histogram, Re-sampling, K-NN Algorithm, Distance Matrix. First, Histogram gives the total number of specified value of pixels distributed in a particular image. Re-sampling re-size image to 629X 839 for proper geometrical representation. Classification and identification of brain tumor by using k-NN which is based on training. In this work Manhattan metric has applied and calculated the distance of the classifier. The algorithm has been implemented using the Lab View. Algorithm has been tested on 48 images. The identification score for all images are about 95%.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

In this existing method, the brain tumor is detected by selecting a region of interest using an Active contour (AC) and using the symmetric characteristics of the human brain anatomy. The brain tumor can be occur in any part of the brain and can take any shape formation. So, intensity variations in the brain MRI are either due to the structural components of the brain, or due to the presence of the tumor. In this method find out multiple region-patches that have a lower intensity range. Segmentation of the region is then accomplished by evolving the AC from an initial contour obtained from the region preserved in the detection phase.

3.1.1 DRAWBACKS

- This method uses AC at multiple steps, and it is fully automatic in both tumor detection and segmentation.
- Both the detection and segmentation phase of the algorithm are designed to work in a fully autonomous manner, so there are chances to generate false results which may leads to insufficient diagnosis.

3.2 PROPOSED SYSTEM

In this proposed work the brain tumor has been detected by using a algorithm called OTSU Threshold Segmentation. The first process will be preprocessing the image, where the MRI (Magnetic Resonance Imaging) will be given as input. This sample image has been taken from various patients at various stages. Since MRI input image contains RGB (Red Blue Green) mixing in it. Then the RGB (Red Green Blue) image will be converted into grey image by using grey scale algorithm. Then the brain image will be filtered by high pass filter, medium pass filter and Low pass filter. Then OTSU Threshold segmentation will separate the image as foreground and background image and then the image is converted into pixels. After the conversion it checks with binary value if the value is 1 then the brain tumor has been detected. If the image value is 0 then the brain tumor has not been detected. Then the morphological operation will happen, where the erosion will remove pixels on object boundaries in the brain image. If the brain MRI image is free from brain tumor means or brain tumor not detected means, it display as brain tumor not found. The next process is bounding box the brain tumor detected image will be shown in the rectangle box. The next process is tumor outline the detected tumor will be shown as image. The detected brain tumor will be indicated in a brightest colour. This detection and extraction process is done by using MATLAB tool

3.2.1 ADVANTAGES

- Since it uses OTSU to detect tumor affected region, it attains high efficiency in diagnosis of brain tumor.
- It eliminates human error may occur at the process of detecting tumor cells Brain MRI images.
- Image segmentation process and many image filtering techniques for accuracy.

CHAPTER 4

SYSTEM SPECIFICATIONS

4.1 SPECIFICATION

A System Requirements Specification (SRS is also known as a Software Requirements Specification) is a document or set of documentation that describes the features and behavior of a system or software application. It includes a variety of elements (see below) that attempts to define the intended functionality required by the customer to satisfy their different users.

It is a structured collection of information that embodies the requirements of a system. A software document is primarily prepared for a project, software or any kind of application.

4.1.1 SOFTWARE SPECIFICATION

- Operating System : Windows 10
- System type : 64-bit OS, X64 based processor
- Tool : MATLABR2017A

4.1.2 HARDWARE SPECIFICATION

- Processor : Intel
- Ram : 4GB
- Hard Disk : 50GB Minimum
- Monitor : 15 inch LCD
- Mouse : Logitech

CHAPTER - 5
SOFTWARE DESCRIPTION

5.1 MATLAB

- MATLAB (matrix laboratory) is a fourth-generation high-level programming language and interactive environment for numerical computation, visualization and programming.
- MATLAB is developed by Math Works.
- It allows matrix manipulations; plotting of functions and data; implementation of algorithms; creation of user interfaces; interfacing with programs written in other languages, including C, C++, Java, and FORTRAN, analyze data, develop algorithms and create models and applications.
- It has numerous built-in commands and math functions that help you in mathematical calculations, generating plots, and performing numerical methods.

5.2 MATLAB's Mathematics

MATLAB is used in every facet of computational mathematics.

Following are some commonly used mathematical calculations where it is used most commonly:

- Dealing with Matrices and Arrays
- 2-D and 3-D Plotting and graphics
- Linear Algebra
- Algebraic Equations
- Non-linear Functions
- Statistics
- Data Analysis
- Calculus and Differential Equations

- Numerical Calculations
- Integration
- Transforms
- Curve Fitting
- Various other special functions

5.2.1 Features of MATLAB

Following are the basic features of MATLAB −

- It is a high-level language for numerical computation, visualization and application development.
- It also provides an interactive environment for iterative exploration, design and problem solving.
- It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.
- It provides built-in graphics for visualizing data and tools for creating custom plots.
- MATLAB's programming interface gives development tools for improving code quality maintainability and maximizing performance.
- It provides tools for building applications with custom graphical interfaces.
- It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

5.2.2 Uses of MATLAB

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams.

It is used in a range of applications including :

- Signal Processing and Communications
- Image and Video Processing
- Control Systems

- ➢ Test and Measurement
- ➢ Computational Finance
- ➢ Computational Biology

5.2.3 MATLAB System

The MATLAB system consists of five main parts:

The MATLAB language is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both "programming in the small" to rapidly create quick and dirty throw-away programs, and "programming in the large" to create complete large and complex application programs.

MATLAB working environment is the set of tools and facilities that you work with as the MATLAB user or programmer. It includes facilities for managing the variables in your workspace and importing and exporting data. It also includes tools for developing, managing, debugging, and profiling M-files, MATLAB's applications.

Handle Graphics this is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete Graphical User Interfaces on your MATLAB applications.

MATLAB mathematical function library is a vast collection of computational algorithms ranging from elementary functions like sum, sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix Eigen values, Bessel functions, and fast Fourier transforms.

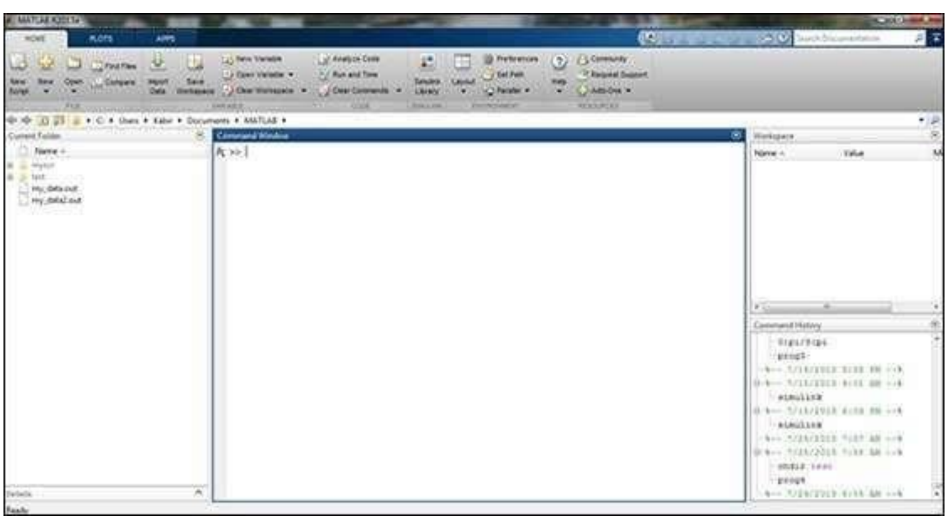
MATLAB Application Program Interface (API) is a library that allows you to write C and FORTRAN programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.

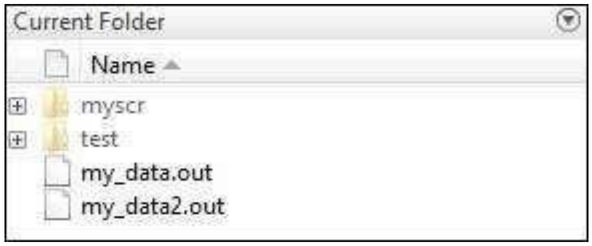
5.2.4 Local Environment Setup

Setting up MATLAB environment is a matter of few clicks. The installer can be downloaded from here.

MathWorks provides the licensed product, a trial version and a student version as well. You need to log into the site and wait a little for their approval. After downloading the installer, the software can be installed through few clicks

Understanding the MATLAB Environment: MATLAB development IDE can be launched from the icon created on the desktop. The main working window in MATLAB is called the desktop. When MATLAB is started, the desktop appears in its default layout





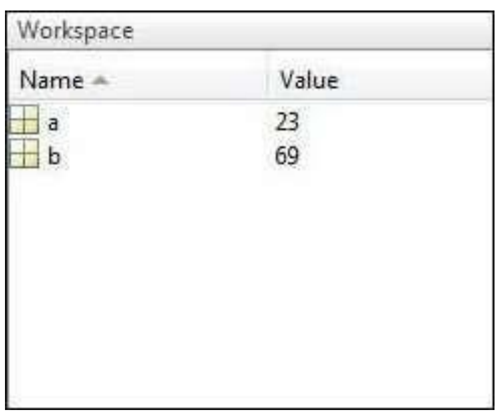
The desktop has the following panels −

Current Folder − this panel allows you to access the project folders and files.

Command Window − this is the main area where commands can be

Entered at the command line. It is indicated by the command prompt (>>).

Workspace − the workspace shows all the variables created and/or



imported from files.

Command History − this panel shows or return commands that are entered at the command line.

CHAPTER 6

SYSTEM DESIGN

6.1 ARCHITECTURE DIAGRAM

An architecture diagram is a graphical representation of a set of concepts that are part of architecture, including their principles, elements and components. There are many kinds of architecture diagrams, like a software architecture diagram, system architecture diagram, application architecture diagram, security architecture diagram, etc.

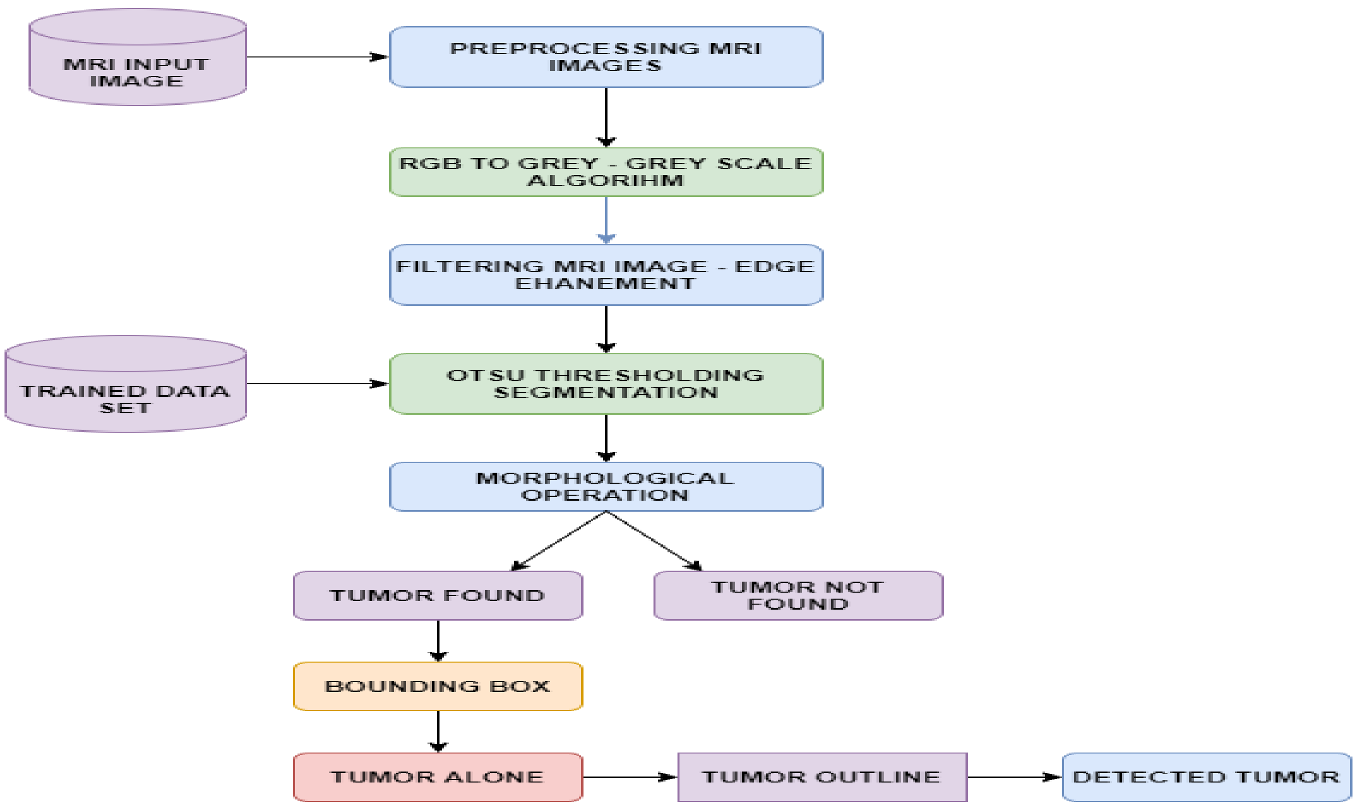


Fig 6.1 Architecture Diagram

This Architecture diagram demonstrates the process of brain tumor detection like preprocessing, RGB to Grey conversion, filtering, OTSU Threshold Segmentation, and Morphological operation and the detected tumor inside the brain. Once the tumor is found it will be processed it is highlighted and dis6played as rectangular form and it also indicate as brightest color by excluding the other part of the brain.

6.2 USECASE DIAGRAM

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well. The use cases are represented by either circles or ellipses.

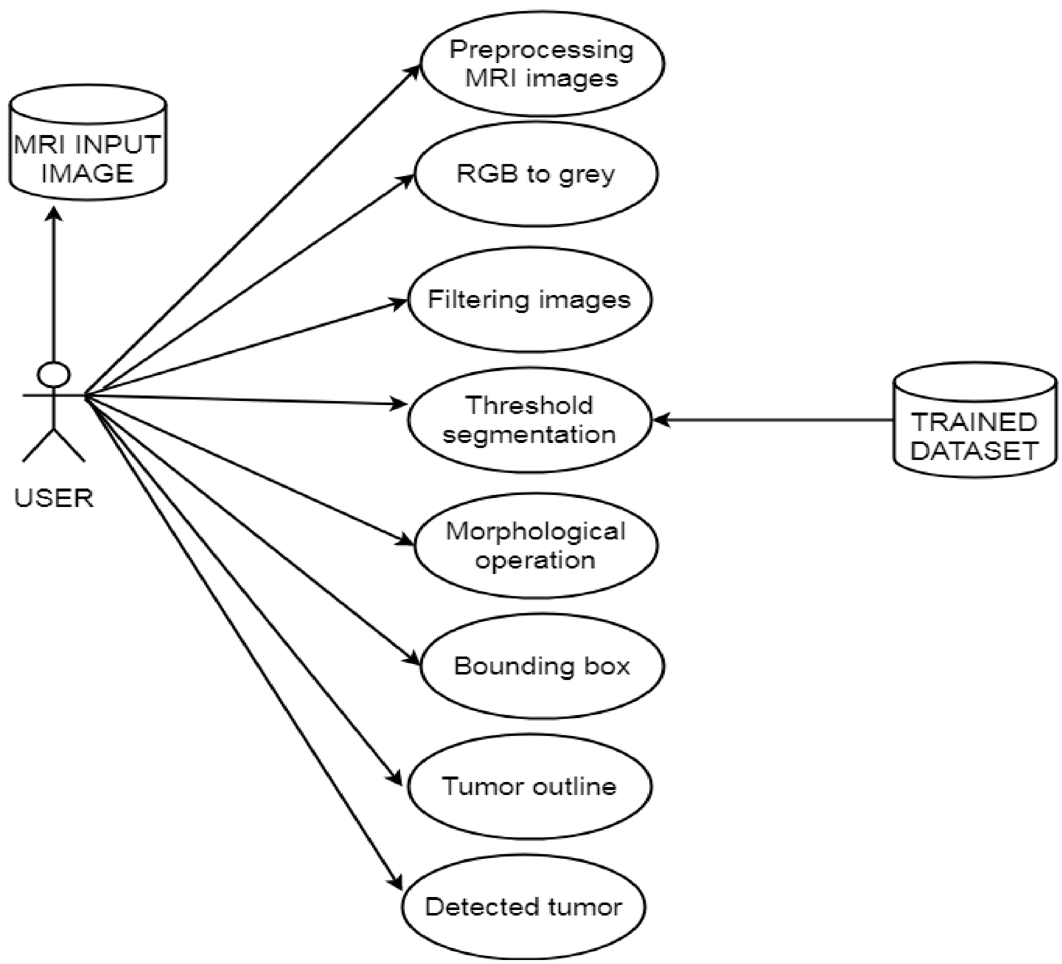


Fig 6.2 Use-Case Diagram

This use case diagram demonstrates the flow of the process where we can get the dataset of MRI (Magnetic Resonance Imaging) from users and that MRI images can be checked whether the tumor is present or not through the threshold segmentation process.

6.3 ACTIVITY DIAGRAM

An activity diagram visually presents a series of actions or flow of control in a system similar to a flowchart or a data flow diagram. Activity diagrams are often used in business process modeling. They can also describe the steps in a use case diagram. Activities modeled can be sequential and concurrent.

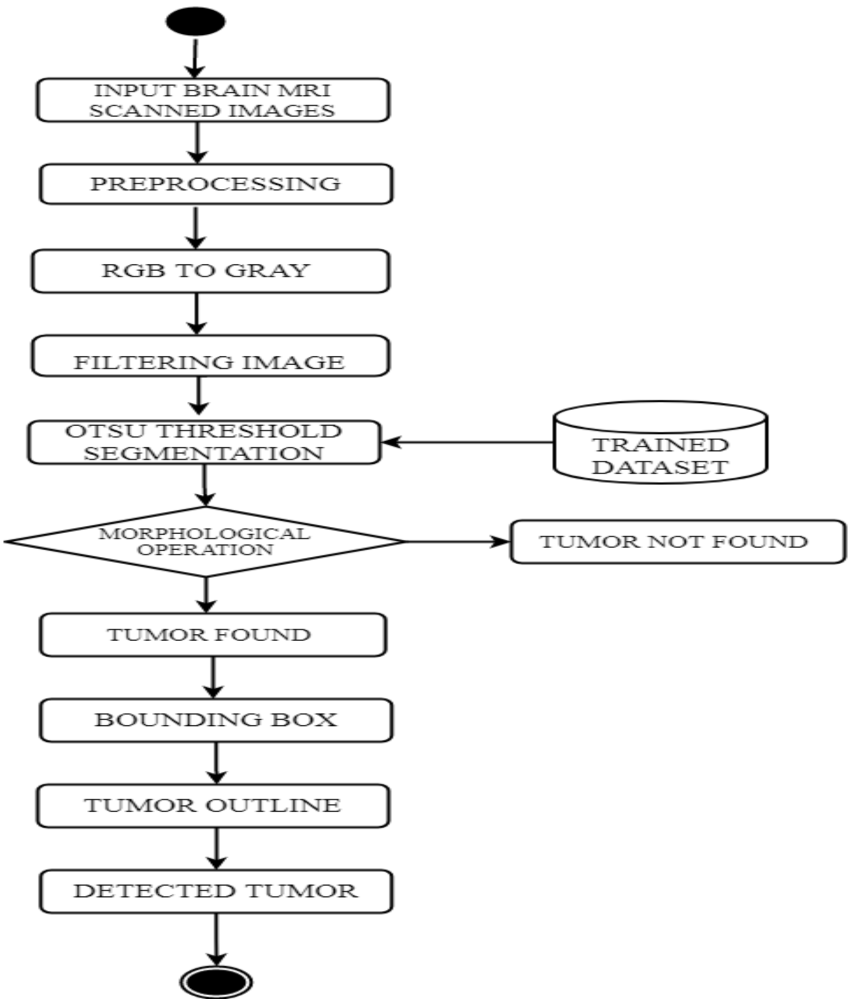


Fig 6.3 Activity Diagram

This Activity diagram demonstrates the process of starting to end and describes the step by step process, where preprocessing, filtering, segmentation, detection. Once the tumor is found it will be processed it is highlighted and displayed as rectangular form and it also indicate as brightest color by excluding the other part of the brain.

6.4 SEQUENCE DIAGRAM

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. Sequence diagrams are sometimes called event diagrams or event scenarios.

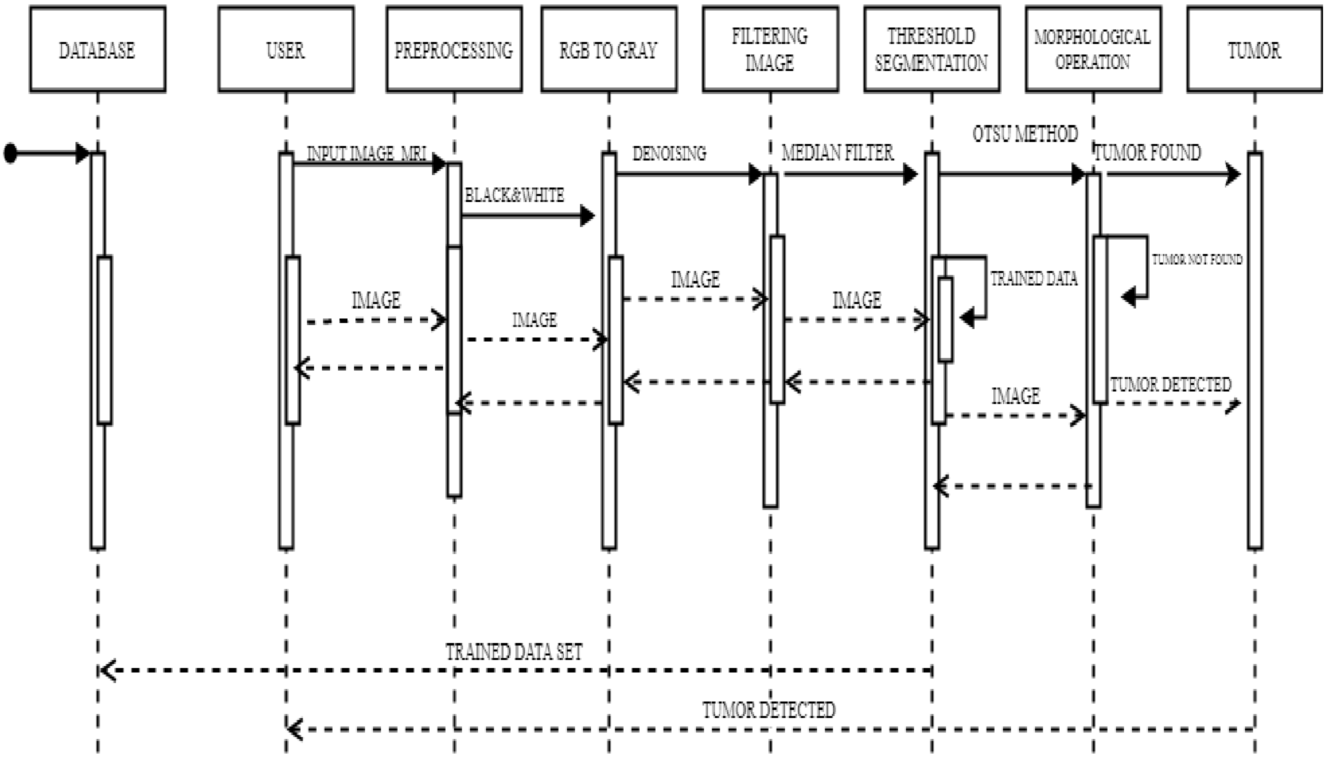


Fig 6.4 Sequence Diagram

This sequence diagram demonstrates the sequence process of brain tumor detection First the MRI images scans and filter the image accordingly. The next process is to segment the image and detect the tumor. By following all the procedure if the tumor has not found means, it display has not found.

6.5 CLASS DIAGRAM

Class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application.Class diagram describes the attributes and operations of a class and also the constraints imposed on the system. The class diagrams are widely used in the modelling of object-oriented systems because they are the only UML diagrams, which can be mapped directly with object-oriented languages.

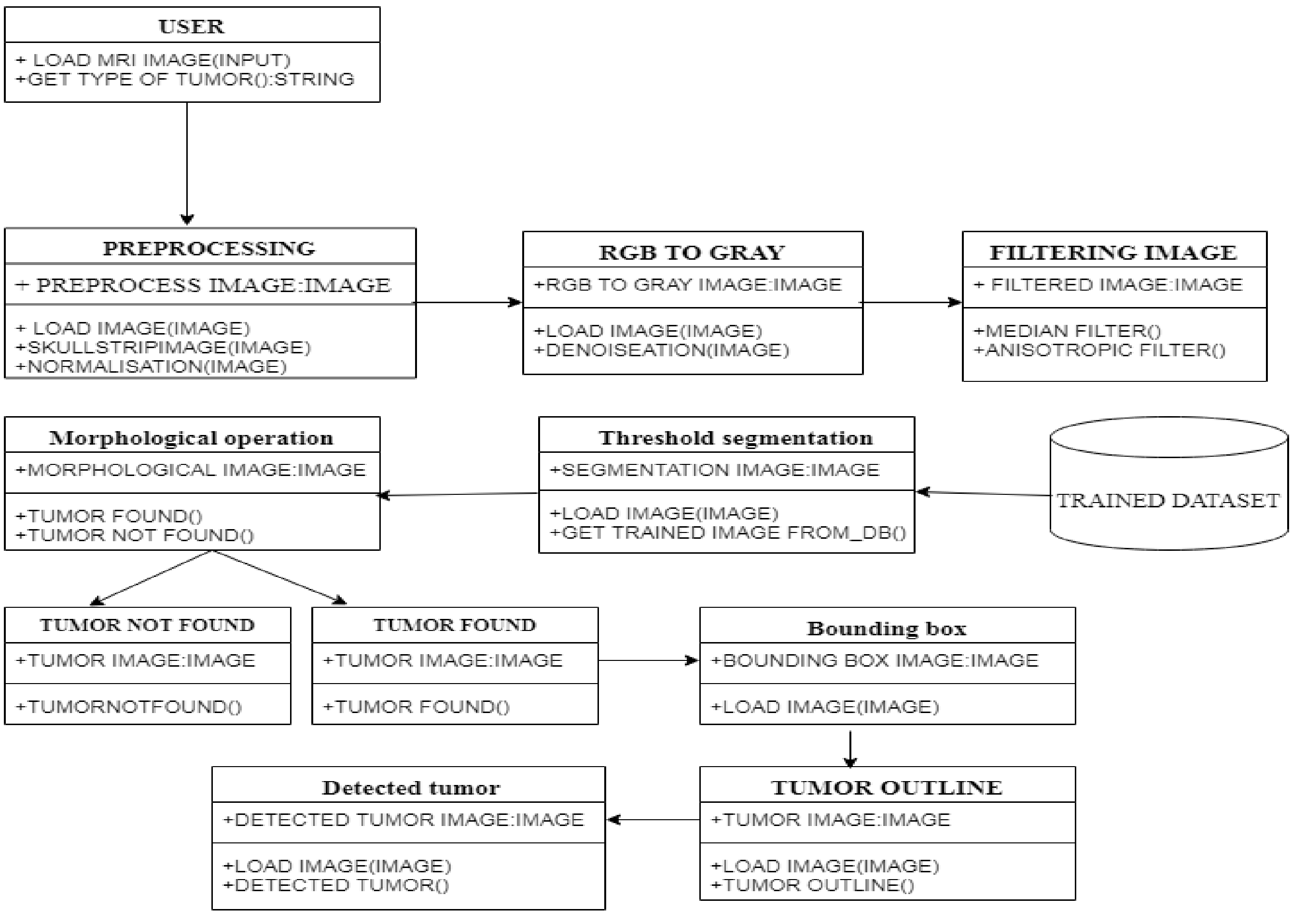


Fig 6.5 Class diagram

This class diagram describes the process and methods of brain tumor detection. First process would be loading the image and it follows the method of conversion like RGB to Grey conversion and segmentation process and finally detection.

6.6 STATECHART DIAGRAM

A State chart diagram is one of the five UML diagrams used to model the dynamic nature of the system. They define different states of an object during its lifetime and these states are changed by events. State chart diagrams are useful to model the reactive system. State chart diagram describes the flow of control from one state to another state. States are defines as a condition in which an object exists and it changes when some event is triggered.

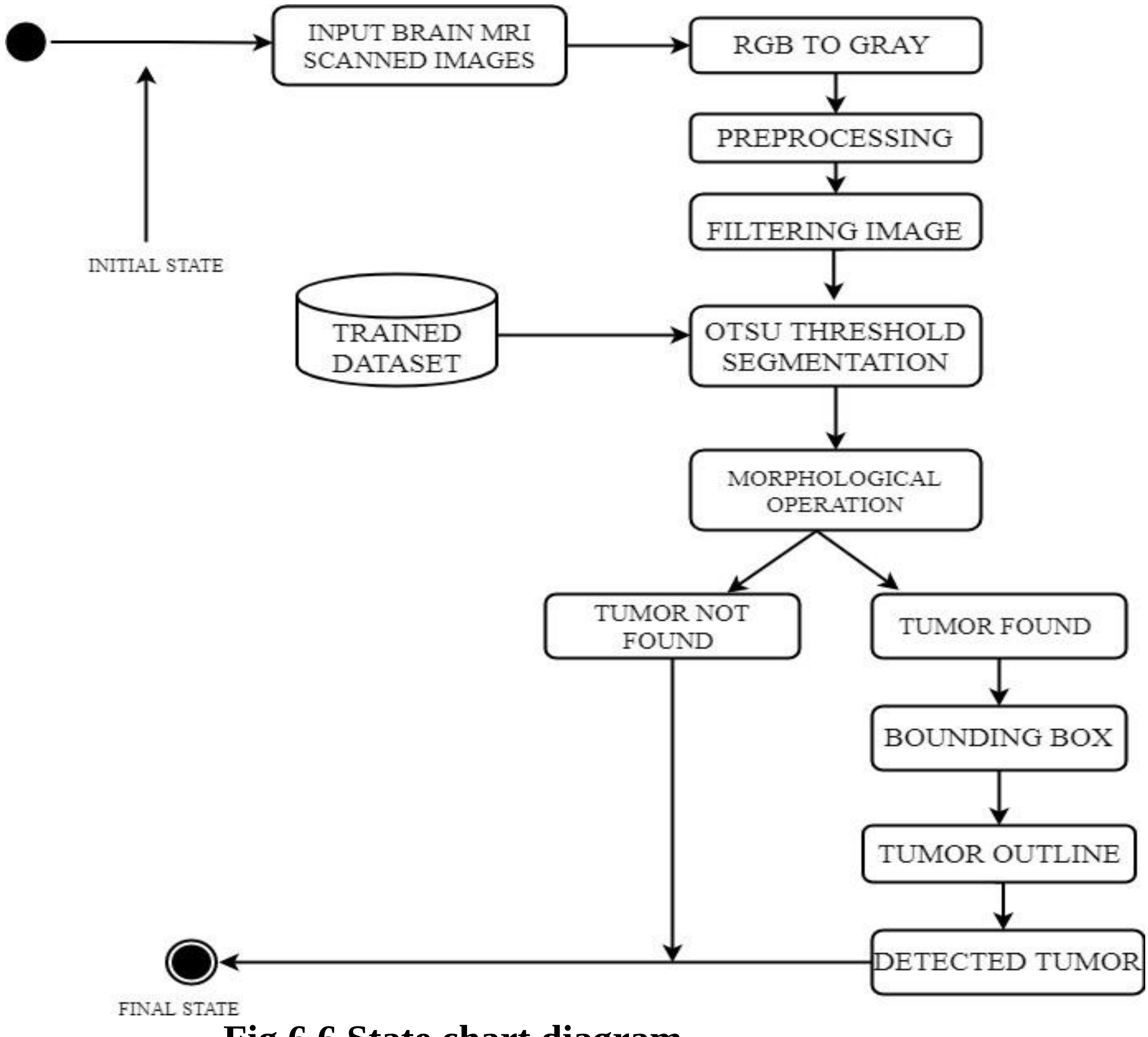


Fig 6.6 State chart diagram

This state chart diagram describes the start to end process, first the MRI image get loaded and follows the process. Once the tumor is found it will be processed it is highlighted and displayed as rectangular form and it also indicate as brightest color by excluding the other part of the brain

6.7 COLLABORATION DIAGRAM

The collaboration diagram is used to show the relationship between the objects in a system. Both the sequence and the collaboration diagrams represent the same information but differently. Instead of showing the flow of messages, it depicts the architecture of the object residing in the system as it is based on object-oriented programming. An object consists of several features. Multiple objects present in the system are connected to each other. The collaboration diagram, which is also known as a communication diagram, is used to portray the object's architecture in the system.

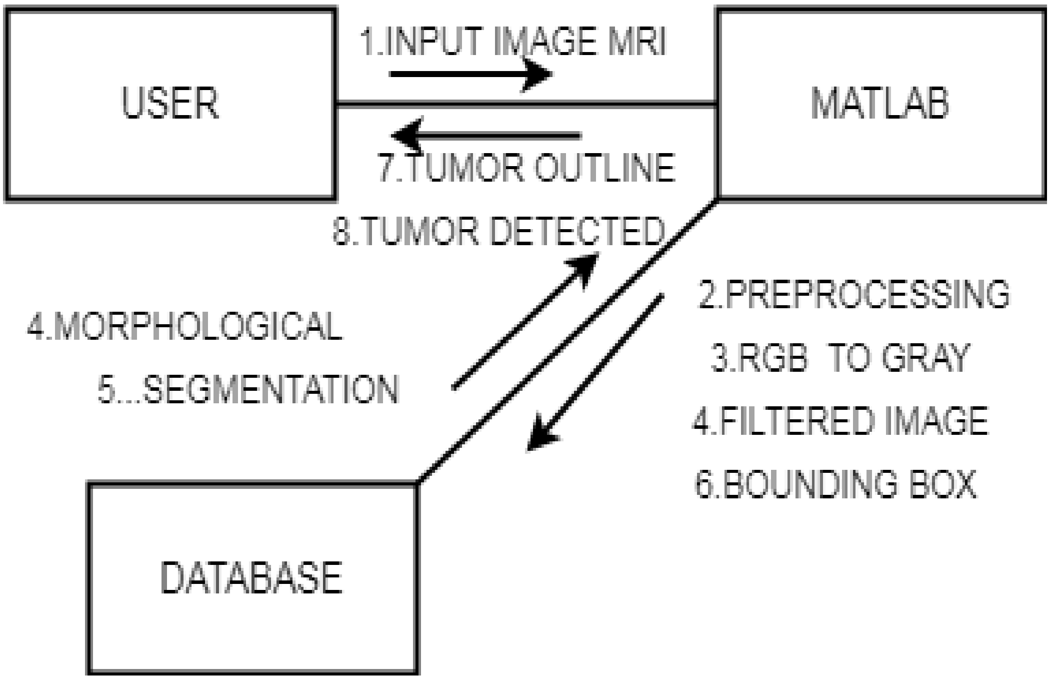


Fig 6.7 Collaboration diagram

This collaboration diagram follows the similar steps of sequence and detects the brain tumor and follows the similar steps like preprocessing, filtering, segmentation and detection. Once the tumor is found it will be processed it is highlighted and displayed as rectangular form and it also indicate as brightest color by excluding the other part of the brain

CHAPTER 7
PROJECT DESCRIPTION

7.1 MODULES

- Preprocessing MRI images
- Filtering images
- Threshold segmentation
- Bounding box
- Detected tumor

7.2 MODULES DESCRIPTION

Module description provides detailed information about the module and its supported components, which is accessible in different manners.

7.2.1 PREPROCESSING MRI IMAGES

The aim of preprocessing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing, although geometric transformation of images (e.g., rotation, scaling, translation) are classified among preprocessing methods here since similar techniques are used. MRI images are magnetic resonance images which can be acquired on computer when a patient is scanned by MRI machine. It has the RGB (Red Green Blue) mixing present in it. Since MRI input image contains some RGB mixing in it, we cannot get a clear expected output. Hence the input image is converted to gray scale image which is the black and white image.

This is the initial step of image processing it is utilized to help in improving parameter of MRI images. Where the input of MRI images can be color image or black and white image. The parameter incorporate signal – to-noise ratio, enhancement in visual appearance of MR image ,the evacuation of insignificant noise and foundation of undesired part, smoothing region of internal part, maintain significant edges. It has the RGB mixing present in it .since MRI input image contain some RGB mixing in it.

We cannot get clear expected output. Hence input image is converted to gray scale image which is black and while image.

7.2.2 RGB TO GREY

An RGB image can be viewed as three images (a red scale image, a green scale image and a blue scale image) stacked on top of each other. In MATLAB, an RGB image is basically a M*N*3 array of colour pixel, where each colour pixel is a triplet which corresponds to red, blue and green colour component of RGB image at a specified spatial location. Similarly, A Gray scale image can be viewed as a single layered image. In MATLAB, a greyscale image is basically M*N array whose values have been scaled to represent intensities. Gray scale image viewed as single layered image.

In MATLAB, there is a function called rgb2gray () is available to convert RGB image to grayscale image.

Algorithm for RGB to Gray

1. Read RGB colour image into MATLAB environment
2. Extract Red, blue and green colour components from RGB image into 3 different 2-D matrices
3. Create a new matrix with the same number of rows and columns as RGB image, containing all zeros.
4. Convert each RGB pixel values at location (i, j) to grayscale values by forming a weighted sum of the Red, Green, and Blue colour components and assign it to corresponding location (i, j) in new matrix.

```
for i=1:M
    for j=1:N
        gray_img(i, j)=(R(i, j)*0.2989)+(G(i, j)*0.5870)+(B(i, j)*0.114);
        end
    end
end
```

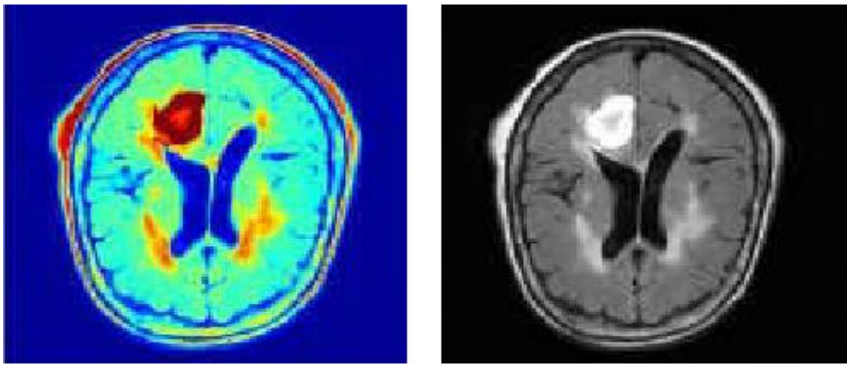


Fig 7.2.2 RGB to Grey conversion

7.2.3 Filtering images

An image filter is a technique through which size, colors, shading and other characteristics of an image are altered. An image filter is used to transform the image using different graphical editing techniques. Image filters are usually done through graphic design and editing software.

Filter is a device or process that removes some unwanted components or features from a signal. It is used to perform Noise removal and image enhancement. Filter is a technique for modifying or enhancing an image. For example, we can filter an image to emphasize certain features or remove other features. Filtering images involved process like median filter and high pass filter. Filtering is a neighborhood operation, in which the value of any given pixel in the output image is determined by applying some algorithm to the value of the pixels in the neighborhood of the corresponding input pixels. A pixel's neighborhood is some set of pixels, defined by their locations relative to that pixel.

7.2.4 THRESHOLD SEGMENTATION

Segmentation is the process of partitioning the images into multiple images segmentation. Segmentation is the method that has been used to separate at a computerized image into many parts that incorporate arrangements of pixels and collection of super pixels.

Thresholding strategy is the most forward method of picture division. Threshold method is based on the threshold value to turn a gray scale image into binary image.

OTSU (OTSU's method, named after Nobuyuki Otsu) used to perform automatic image thresholding. In the simplest form, the algorithm returns a single intensity threshold that separate pixels into two classes, foreground and background. The goal of segmentation is to simplify the representation of an image into something that is more meaningful and easier to analyze.

Threshold segmentation is one of the simplest method in the segmentation techniques. In this method, the pixels are divided according to the intensity value and are separated. The basic idea of thresholding is to select an optimal gray-level threshold value

for separating objects of interest an image from the background based on their gray-level distribution. Otsu method is type of global thresholding in which it depend only on gray value of the image. It is widely used because it is simple and effective. Otsu's thresholding chooses the threshold to minimize the interclass variance of the threshold black and white pixels. Otsu's method is implemented in MATLAB as "gray thresh". In this method, two-dimensional histogram is projected onto the diagonal and then applied to 2D Otsu on that histogram to find the optimal threshold value. The result of experiment showed that it operates directly on the gray level histogram so it greatly enhanced the speed of thresholding and has better noise immunity. As a result of the segmentation, a set of contours extracted from the image. Each of the pixels in a region are similar with respect to some characteristic such as color, intensity, or texture whereas adjacent regions are significantly different with respect to the same characteristic When applied to a stack of images, the resulting contours after image segmentation can be used to create 3D reconstructions.

OTSU THRESHOLDING SEGMENTATION ALGORITHM

STEP1: Functions of inputs and output

STEP2: Histograms is a 256*256 2D-histogram of grayscale value and neighborhood average grayscale value pair.

STEP 3: Total is the number of pairs in the given image. It is determined by the number of the bins of 2D-histogram at each direction.

ALGORITHM

```
sout=imresize(inp,[256,256]);
t0=60;
th=t0+((max(inp(:))+min(inp(:)))./2);
for i=1:1:size(inp,1)
for j=1:1:size(inp,2)
        if inp(i,j)>th
            sout(i,j)=1;
        else

        sout(i,j)=0;
        end
    end
end
```

This algorithm will return a image of threshold intensity which separates as pixels into two forms such as foreground images and background images. Image pixel can be divided as minimum and maximum and it checks with the condition as the intensity of input image is greater than threshold value then the brain tumors detected. If the intensity of input is lesser than

7.2.5 MORPHOLOGICAL OPERATION

Morphological image processing is a collection of non-linear operations related to the shape or morphology of the feature in an image. Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of same. It is a tool for extracting image components that are useful in the representation and description of region shape, such as Boundaries extraction, Morphological filtering, thinning. Morphology refers to the description of the properties of the shape and structure of the objects. Here binary image consists of various imperfections. Thresholding is distorted by the noise and texture features. Morphological operations are logical transformation based on the comparison of the pixel neighborhood with a pattern. These operations are usually performed on the binary images where the pixel value is between 0 and 1.

7.2.6 BOUNDING BOX

A Bounding box is a temporary outline which highlights objects in creative software such as Photoshop, 3ds Max and Google Docs. Bounding box usually allows users to manipulate the object with transformation tools, such as scaling, moving or rotating.

Bounding boxes will disappear when the object is no longer selected and do not appear in the final exported file. Bounding box is an imaginary rectangle that serves as a point of reference for object detection and creates a collision box for that object.

In this process, the tumor detected and it indicates by the rectangular bounded form.

Data annotators draw these rectangles over images, outlining the object of interest within each image by defining its X and Y coordinates. This makes it easier for machine learning algorithms to find what they’re looking for, determine collision paths, and conserves valuable computing resources. Bounding boxes are one of the most popular image annotation techniques in deep learning. Compared to other image processing methods, this method can reduce costs and increase annotation efficiency.

7.2.7 TUMOR OUTLINE

In this process the tumor alone indicated by eliminating the other part of the images, by analyzing process the tumor easily seen in the images. By analyzing this process, we can easily identify the part which has been affected

7.2.8 DETECTED TUMOR

As diagnosis tumor is a complicated and sensitive task; therefore, accuracy and reliability are always assigned much importance. Hence, an elaborated methodology that highlights new vistas for developing more robust image segmentation technique is much sought. Here figures show the images as an output. I.e. grayscale image, high pass filtered image, threshold image, Finally input image and extracted tumors from MRI image. For this purpose real time patient data is taken for analysis. As tumors in MRI image have intensity more than that of its background so it become very easy locate it and extract it from a MRI image.

Finally, the brain tumor get detected and it is indicates by a brightest color. If the test person is free from tumor the result shows as tumor not found.

CHAPTER 8

RESULT AND DISCUSSION

8.1 TABULATION

Algorithm	MRI1	MRI2	MRI3	MRI4	MRI5
OTSU	94.85	94.55	91.89	96.21	93.6
AC	83.45	79.98	83.67	87.23	83.56
FCM	87.54	75.34	85.97	86.54	75.52

TABLE 8.1: SEGMENTATION ACCURACY OF EXISTING METHOD AND PROPOSED METHOD

Where as

MRI – Magnetic Resonance Imaging

AC – Active Contour

FCM- Fuzzy C-means

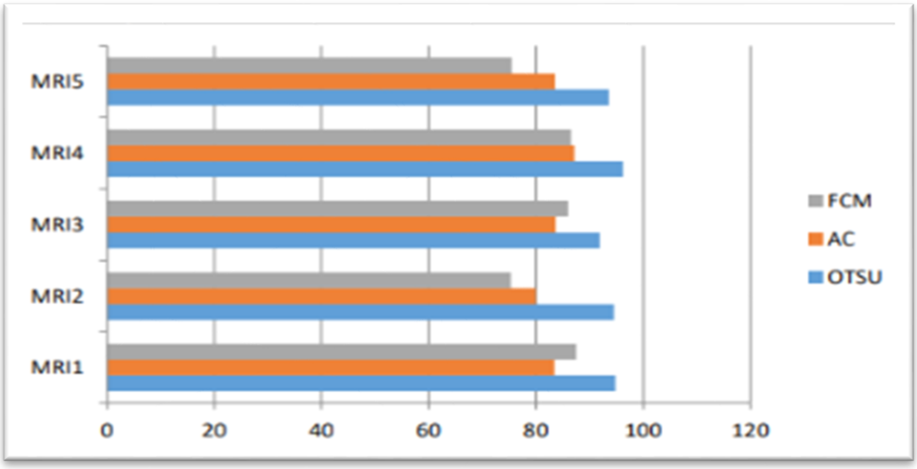


Figure 8.1 Segmentation Accuracy graphs of existing and proposed methods

In this graph it indicates the experimental effects of the proposed algorithm in detecting various brain tissues and the contrast with different strategies.

Where OTSU (proposed method)

AC (Existing method)

FCM (Existing method)

This graph compares the segmentation accuracy of existing and proposed methods.

	MRI1	MRI2	MRI3	MRI4	MRI5
OTSU	83.57	83.89	83.43	87.21	90.36
AC	79.45	74.9	73.89	73.76	86.45
FCM	77.54	88.91	82.27	78.92	72.32

TABLE 8.2: SENSITIVITY ACCURACY OF EXISTING METHOD AND PROPOSED METHOD

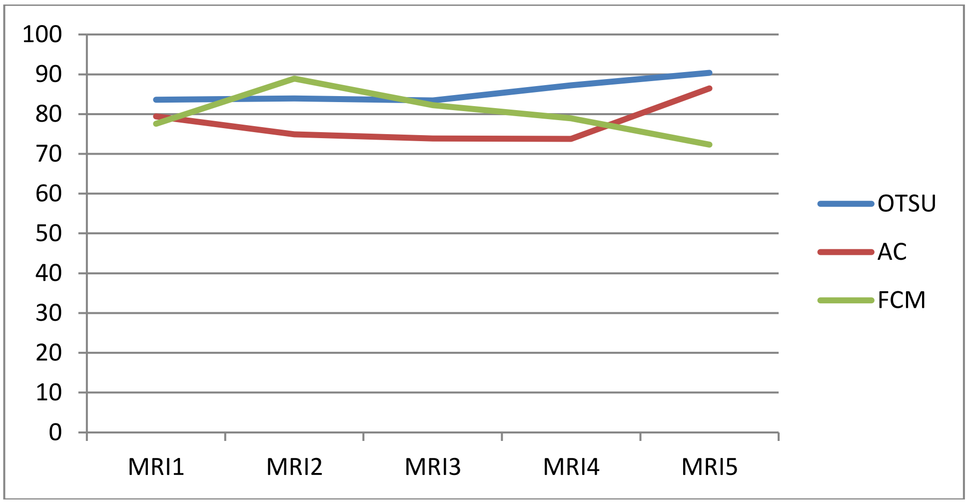


Figure 8.2: Sensitivity accuracy of existing and proposed method

In this graph it indicates the experimental effects of the proposed algorithm in detecting various brain tissues and the contrast with different strategies.

Where OTSU (proposed method)

AC (Existing method)

FCM (Existing method)

This graph compares the sensitivity accuracy of existing and proposed methods .In this graph it indicates the experimental effects of the proposed algorithm in detecting various brain tissues and the contrast with different strategies. The MRI IMAGES of the BRAIN are downloaded from the Brain Web database. Around 20 images are used for testing the proposed algorithm however the consequences of 10 photos are supplied within the paper. The encouraged segmentation method is evaluated the use of the measures segmentation accuracy and sensitivity.

CHAPTER 9

CONCLUSION AND FUTURE ENHANCEMENTS

9.1 CONCLUSION

In this research work the brain tumor has been detected by using a algorithm called OTSU Threshold Segmentation. The first process was preprocessing the image, where the MRI (Magnetic Resonance Imaging) has been given as input. This sample image has been taken from various patients at various stages. Since MRI input image contains RGB (Red Blue Green) mixing in it. Then the RGB (Red Green Blue) image was converted into grey image by using grey scale algorithm. Then the brain image has been filtered by high pass filter, medium pass filter and Low pass filter. Then OTSU Threshold segmentation separates the image as foreground and background image and then the image is converted into pixels. After the conversion it checks with binary value if the value is 1 then the brain tumor has been detected. If the image value is 0 then the brain tumor has not been detected. Then the morphological operation will happen, where the erosion will remove pixels on object boundaries in the brain image. If the brain MRI image is free from brain tumor means or brain tumor not detected means, it display as brain tumor not found. The next process is bounding box the brain tumor detected image will be shown in the rectangle box. The next process is tumor outline the detected tumor will be shown as image. The detected brain tumor will be indicated in a brightest colour. This detection and extraction process is done by using MATLAB tool.

9.2 FUTURE ENHANCEMENT

In this paper, we have detected the brain tumor by following the process of preprocessing, converting RGB to grey image, filtering and segmentation. The MRI images of various patients at various stages are taken to analyze the brain tumor. By analyzing the MRI(Magnetic Resonance Imaging)images of the brain, We detected the tumor by using OTSU Threshold Segmentation Algorithm by following the procedure of preprocessing, RGB(Red Green Blue) to Grey conversion, Filtering, Bounding Box, Segmentation and Detection. There are two types of brain tumor which are malignant (cancerous) this tumor may grow rapidly and it spread throughout the parts of the brain so it is necessary to identify the types of brain tumor and benign (non cancerous) this tumor grows and damage the parts of the brain slowly. After the detection of brain tumor type we can add the parameters to detect and say which type of tumor it is.

.

CHAPTER 10

APPENDIX

SOURCE CODE

MAIN.DOCX

```
clc;                % clear console
close all;           % closes all dialog boxes
clear all;           % clears memory
%% Input
[I,path]=uigetfile('*.jpg','select a input image');
str=strcat(path,I);
s=imread(str);
figure;
imshow(s);
title('Input image','FontSize',15);
%% Filter
num_iter = 10;
delta_t = 1/7;
kappa = 15;
option = 2;
disp('Preprocessing image please wait . . .');
inp = anisodiff(s,num_iter,delta_t,kappa,option);
inp = uint8(inp);

inp=imresize(inp,[256,256]);
if size(inp,3)>1
    inp=rgb2gray(inp);
end
```

```
figure;
imshow(inp);
title('Filtered image','FontSize',15);
%% thresholding
sout=imresize(inp,[256,256]);
t0=60;
th=t0+((max(inp(:))+min(inp(:)))./2);
for i=1:1:size(inp,1)
    for j=1:1:size(inp,2)
        if inp(i,j)>th
            sout(i,j)=1;
        else
            sout(i,j)=0;
        end
    end
end
%% Morphological Operation
label=bwlabel(sout);
stats=regionprops(logical(sout),'Solidity','Area','BoundingBox');
density=[stats.Solidity];
area=[stats.Area];
high_dense_area=density>0.6;
max_area=max(area(high_dense_area));
tumor_label=find(area==max_area);
tumor=ismember(label,tumor_label);
if max_area>100
   figure;
   imshow(tumor)
   title('Tumor Found','FontSize',20);
else
```

```
    h = msgbox('No Tumor!!','status');
    %disp('No tumor');
    return;
end

%% Bounding box
box = stats(tumor_label);
wantedBox = box.BoundingBox;
figure
imshow(inp);
title('Bounding Box','FontSize',20);
hold on;
rectangle('Position',wantedBox,'EdgeColor','y');
hold off;
%% Getting Tumor Outline - image filling, eroding, subtracting
% erosion the walls by a few pixels
dilationAmount = 5;
rad = floor(dilationAmount);
[r,c] = size(tumor);
filledImage = imfill(tumor, 'holes');
for i=1:r
   for j=1:c
       x1=i-rad;
       x2=i+rad;
       y1=j-rad;
       y2=j+rad;
       if x1<1
           x1=1;
       end
       if x2>r
```

```
            x2=r;
        end
        if y1<1
            y1=1;
        end
        if y2>c
            y2=c;
        end
        erodedImage(i,j) = min(min(filledImage(x1:x2,y1:y2)));
end
end
figure
imshow(erodedImage);
title('eroded image','FontSize',20);
%% subtracting eroded image from original BW image
tumorOutline=tumor;
tumorOutline(erodedImage)=0;
figure;
imshow(tumorOutline);
title('Tumor Outline','FontSize',20);
%% Inserting the outline in filtered image in green color
rgb = inp(:,:,[1 1 1]);
red = rgb(:,:,1);
red(tumorOutline)=255;
green = rgb(:,:,2);
green(tumorOutline)=0;
blue = rgb(:,:,3);
blue(tumorOutline)=0;
tumorOutlineInserted(:,:,1) = red;
tumorOutlineInserted(:,:,2) = green;
```

```
tumorOutlineInserted(:,:,3) = blue;
figure
imshow(tumorOutlineInserted);
title('Detected Tumer','FontSize',20);
%% Display Together
figure
subplot(231);imshow(s);title('Input image','FontSize',20);
subplot(232);imshow(inp);title('Filtered image','FontSize',20);
subplot(233);imshow(inp);title('Bounding Box','FontSize',20);
hold on;rectangle('Position',wantedBox,'EdgeColor','y');hold off;
subplot(234);imshow(tumor);title('tumor alone','FontSize',20);
subplot(235);imshow(tumorOutline);title('Tumor Outline','FontSize',20);
subplot(236);imshow(tumorOutlineInserted);title('Detected Tumor','FontSize',20);
```

ANISODIFF.DOCX

```
function diff_im = anisodiff(im, num_iter, delta_t, kappa, option)
fprintf('Removing noise\n');
fprintf('Filtering Completed !!');
% Convert input image to double.
im = double(im);
% PDE (partial differential equation
diff_im = im;
% Center pixel distances.
dx = 1;
dy = 1;
dd = sqrt(2);
% 2D convolution masks - finite differences.
hN = [0 1 0; 0 -1 0; 0 0 0];
hS = [0 0 0; 0 -1 0; 0 1 0];
hE = [0 0 0; 0 -1 1; 0 0 0];
```

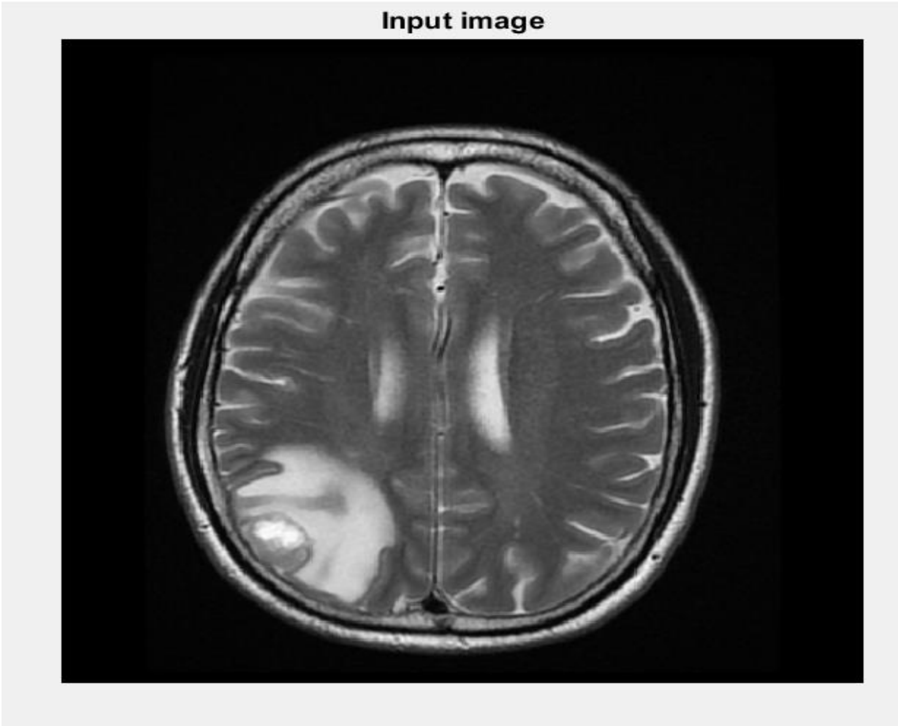
```
hW = [0 0 0; 1 -1 0; 0 0 0];
hNE = [0 0 1; 0 -1 0; 0 0 0];
hSE = [0 0 0; 0 -1 0; 0 0 1];
hSW = [0 0 0; 0 -1 0; 1 0 0];
hNW = [1 0 0; 0 -1 0; 0 0 0];
% Anisotropic diffusion.
for t = 1:num_iter
    % Finite differences. [imfilter(.,.,'conv') can be replaced by conv2(.,.,'same')]
    nablaN = imfilter(diff_im,hN,'conv');
    nablaS = imfilter(diff_im,hS,'conv');
    nablaW = imfilter(diff_im,hW,'conv');
    nablaE = imfilter(diff_im,hE,'conv');
    nablaNE = imfilter(diff_im,hNE,'conv');
    nablaSE = imfilter(diff_im,hSE,'conv');
    nablaSW = imfilter(diff_im,hSW,'conv');
    nablaNW = imfilter(diff_im,hNW,'conv');

    % Diffusion function.
    if option == 1
        cN = exp(-(nablaN/kappa).^2);
        cS = exp(-(nablaS/kappa).^2);
        cW = exp(-(nablaW/kappa).^2);
        cE = exp(-(nablaE/kappa).^2);
        cNE = exp(-(nablaNE/kappa).^2);
        cSE = exp(-(nablaSE/kappa).^2);
        cSW = exp(-(nablaSW/kappa).^2);
        cNW = exp(-(nablaNW/kappa).^2);
    elseif option == 2
      cN = 1./(1 + (nablaN/kappa).^2);
        cS = 1./(1 + (nablaS/kappa).^2);
```

```
            cW = 1./(1 + (nablaW/kappa).^2);
            cE = 1./(1 + (nablaE/kappa).^2);
            cNE = 1./(1 + (nablaNE/kappa).^2);
            cSE = 1./(1 + (nablaSE/kappa).^2);
            cSW = 1./(1 + (nablaSW/kappa).^2);
            cNW = 1./(1 + (nablaNW/kappa).^2);
        end
        % Discrete PDE solution.
        diff_im = diff_im + ...
                delta_t*(...
                (1/(dy^2))*cN.*nablaN + (1/(dy^2))*cS.*nablaS + ...
                (1/(dx^2))*cW.*nablaW + (1/(dx^2))*cE.*nablaE + ...
                (1/(dd^2))*cNE.*nablaNE + (1/(dd^2))*cSE.*nablaSE + ...
                (1/(dd^2))*cSW.*nablaSW + (1/(dd^2))*cNW.*nablaNW );

end

I=imread('C:\Users\dharsh\Desktop\5.jpg');
figure, imshow(I); title('Brain MRI Image');
I = imresize(I,[200,200]);
I= rgb2gray(I);
I= im2bw(I,.6);%binarising with thresold .6
figure, imshow(I);title('Thresholded Image');
hy = fspecial('sobel');
hx = hy';
Iy = imfilter(double(I), hy, 'replicate');
Ix = imfilter(double(I), hx, 'replicate');
gradmag = sqrt(Ix.^2 + Iy.^2);
L = watershed(gradmag);
Lrgb = label2rgb(L);
figure, imshow(Lrgb),
```

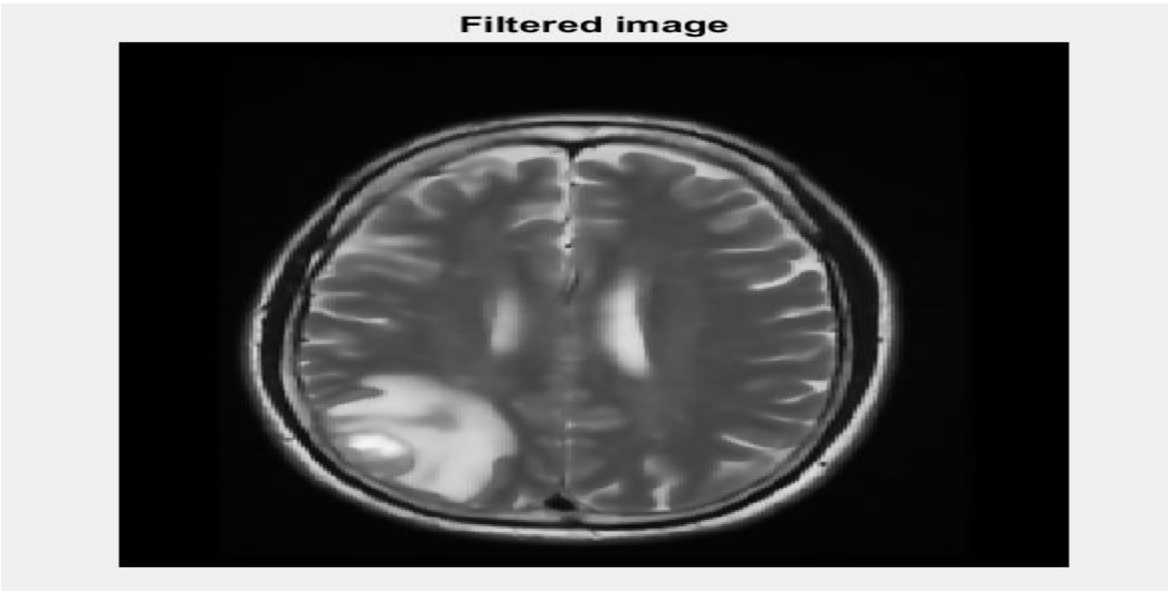
```
se = strel('disk', 20);
Io = imopen(I, se);
Ie = imerode(I, se);
Iobr = imreconstruct(Ie, I);
Iobrd = imdilate(Iobr, se);
Iobrcbr = imreconstruct(imcomplement(Iobrd), imcomplement(Iobr));
Iobrcbr = imcomplement(Iobrcbr);
I2 = I;
fgm = imregionalmax(Iobrcbr);
I2(fgm) = 255;
se2 = strel(ones(5,5));
fgm2 = imclose(fgm, se2);
fgm3 = imerode(fgm2, se2);
fgm4 = bwareaopen(fgm3, 20);
I3 = I;
bw = im2bw(Iobrcbr);
figure
imshow(bw), title('only tumor')

density=[stats.Solidity];
area=[stats.Area];
high_dense_area=density>0.6;
max_area=max(area(high_dense_area));
tumor_label=find(area==max_area);
tumor=ismember(label,tumor_label);
if max_area>100
   figure;
   imshow(tumor)
   title('Tumor Found','FontSize',20);
else
    h = msgbox('No Tumor!!','status');
```

```
    %disp('No tumor');
    return;
end
subplot(231);imshow(s);title('Input image','FontSize',20);
subplot(232);imshow(inp);title('Filtered image','FontSize',20);
subplot(233);imshow(inp);title('Bounding Box','FontSize',20);
hold on;rectangle('Position',wantedBox,'EdgeColor','y');hold off;
subplot(234);imshow(tumor);title('tumor alone','FontSize',20);
subplot(235);imshow(tumorOutline);title('Tumor Outline','FontSize',20);
subplot(236);imshow(tumorOutlineInserted);title('Detected Tumor','FontSize',20);
```

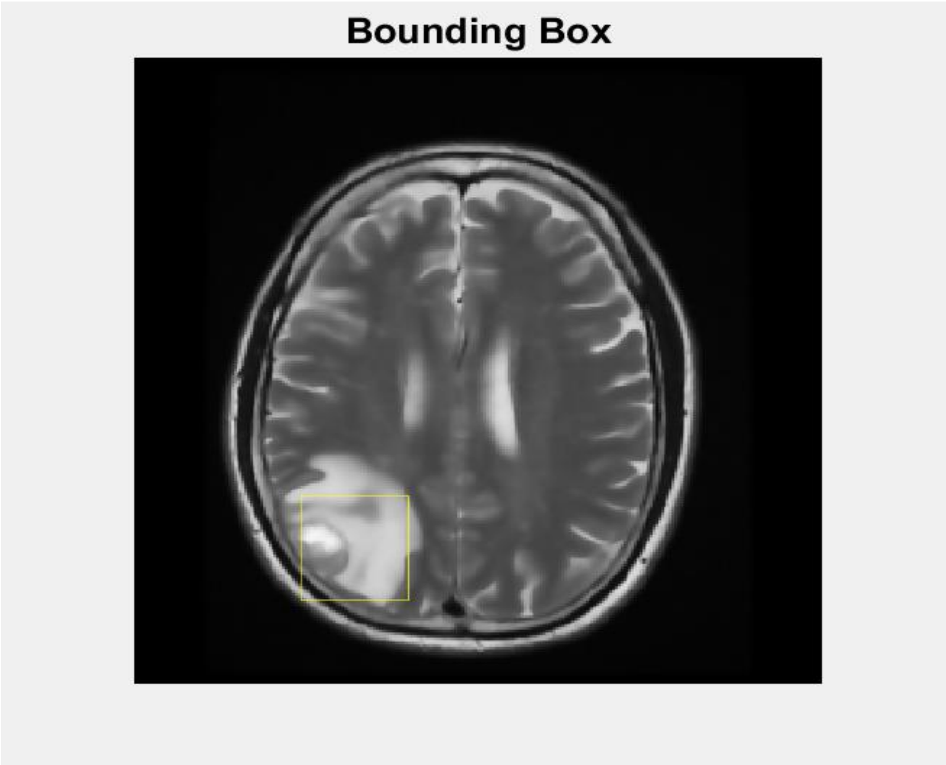
SCREEN SHOTS:



PREPROCESSING MRI INPUT IMAGE

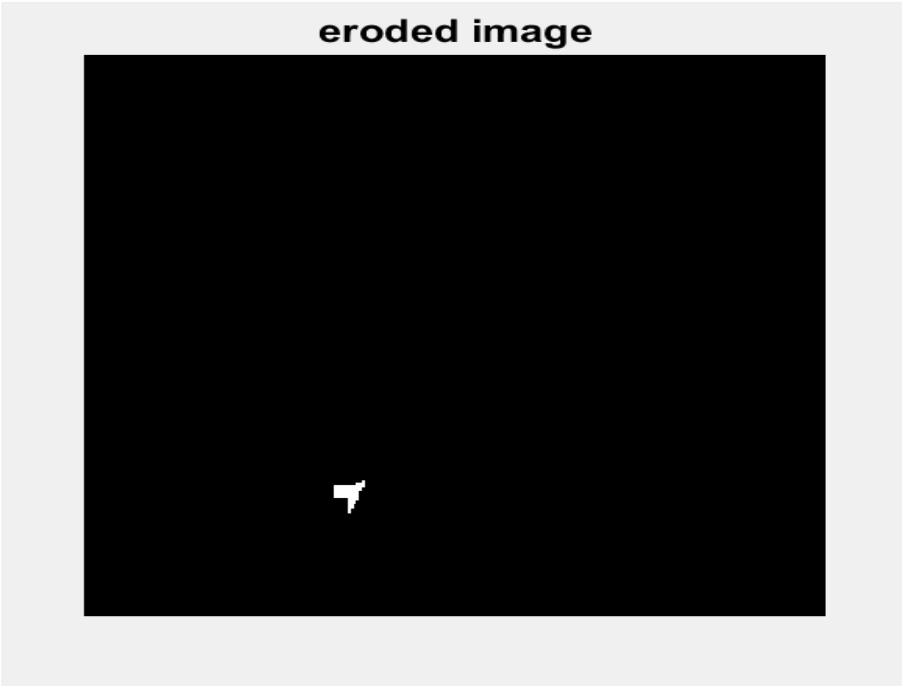


FILTERED MRI IMAGE

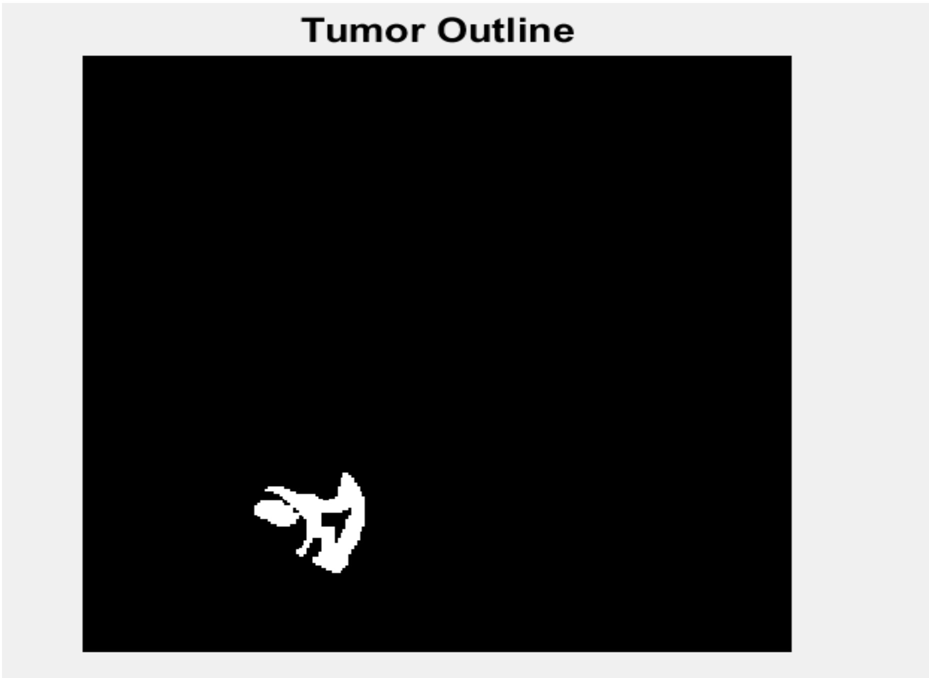


Bounding box Tumor found and displayed as rectangular box

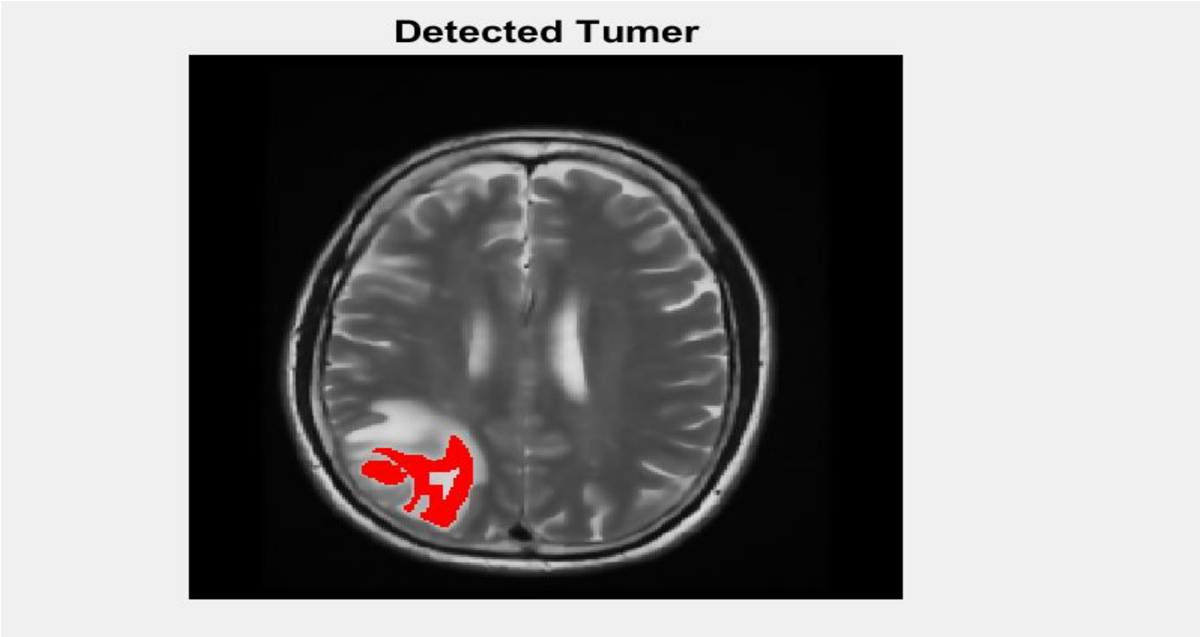
TUMOR DETECTED AND DISPLAYED AS ONLY TUMOR



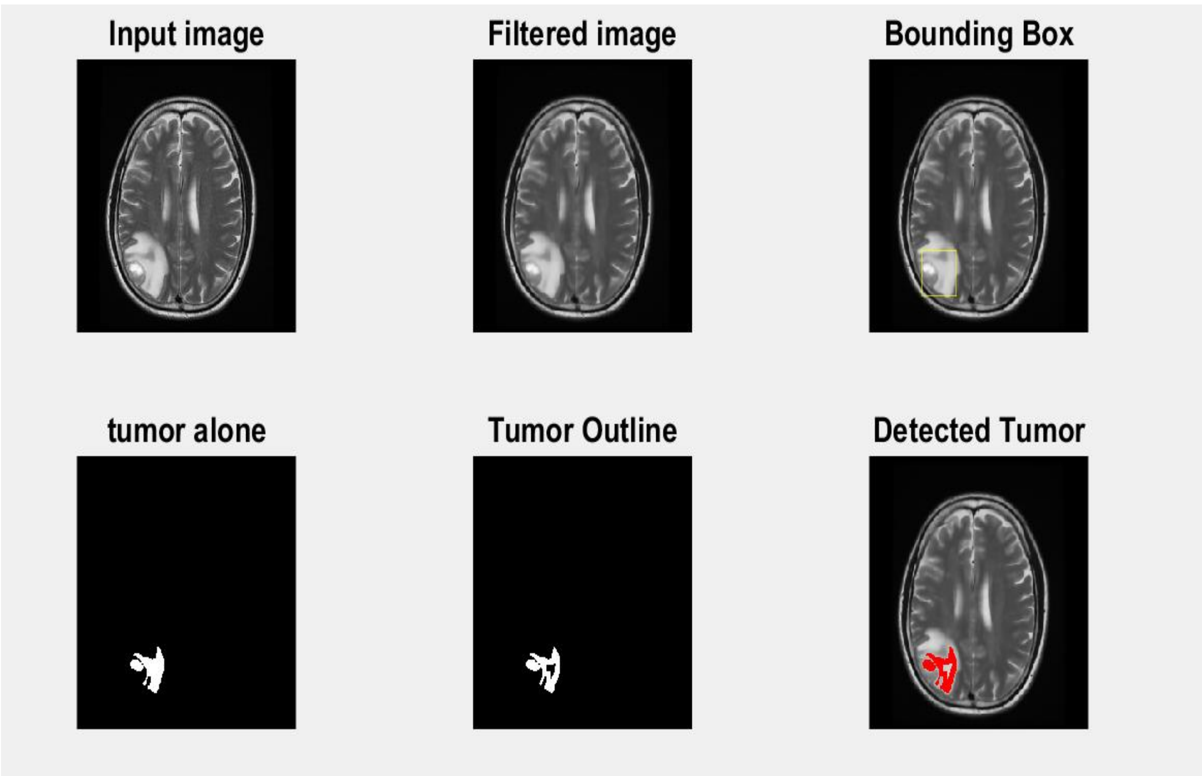
Eroded image the other part of the brain are excluded



BRAIN TUMOR OUTLINE IMAGE

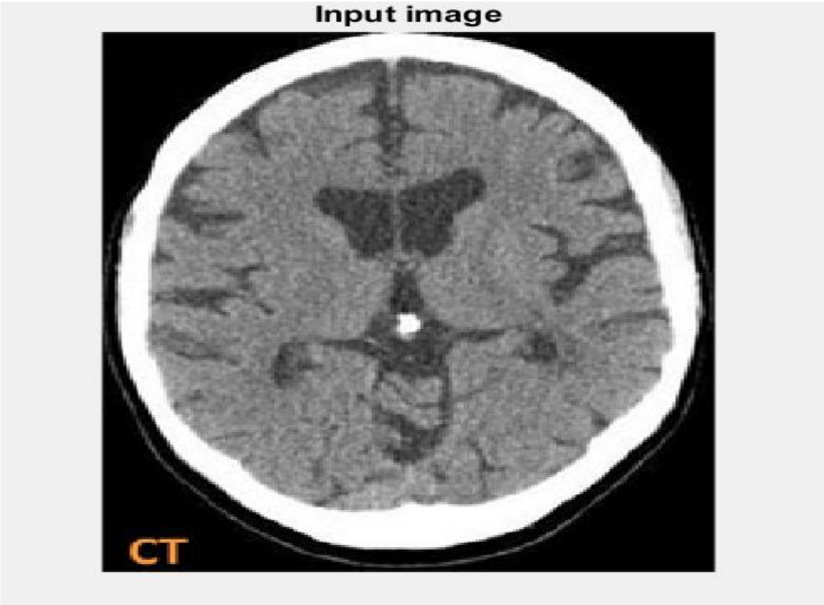


DETECTED TUMOR

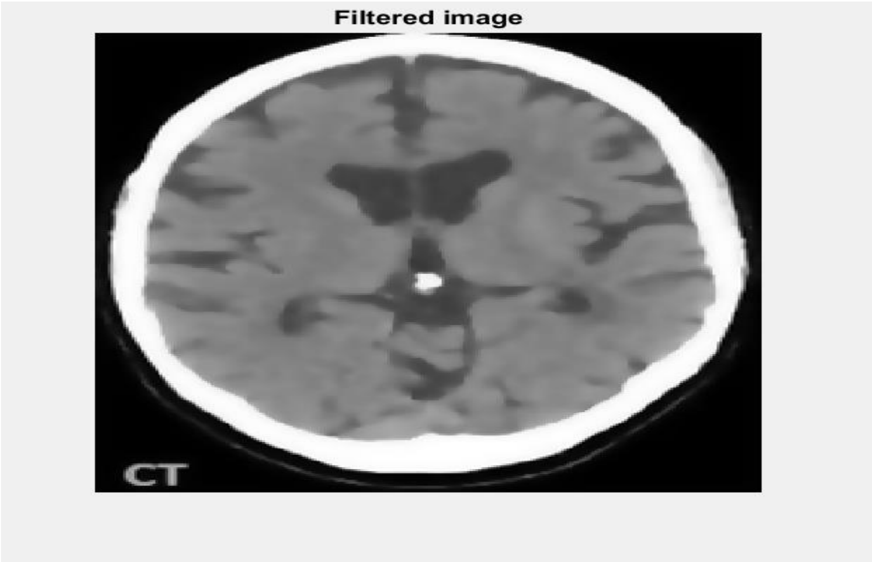


PROCESS OF BRAIN TUMOR DETECTION

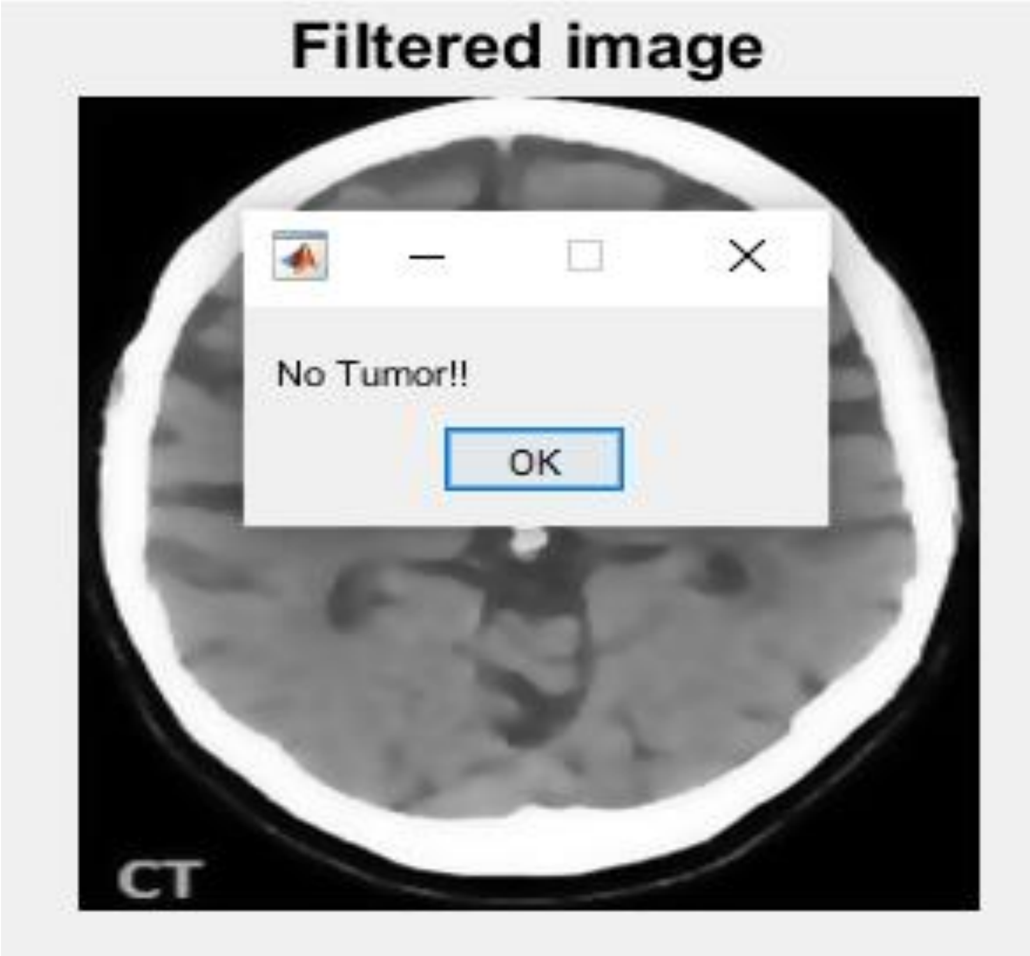
TUMOR NOT FOUND PROCESS



PREPROCESSING MRI INPUT IMAGE



FILTERED MRI IMAGE



TUMOR NOT DETECTED

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