

AUTOMATED CLASSIFICATION OF MRI BRAIN TUMOR USING DEEP NEURAL NETWORKS

Submitted in partial fulfillment of the necessities for the award of Bachelor of
Engineering degree in Electronics and Communication Engineering.

By,

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**DEPARTMENT OF ELECTRONICS AND
COMMUNICATION ENGINEERING**

SCHOOL OF ELECTRICAL AND ELECTRONICS

ENGINEERING.

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

MAY-2022



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BONAFIDE CERTIFICATE

This is often to certify that this Project Report is that the BONAFIDE work of KANIMOZHI D (38130100) And MAHALAKSHMI M (38130124) who applied the project entitled AUTOMATED CLASSIFICATION OF **MRI** TUMOR USING DEEP NEURAL NETWORKS under my /our supervision from December 2021 to April 2022.

Internal Guide

External Guide (If Applicable)

Head of the Department

(Name in Capital letters with Seal & Signature)

Submitted for Viva voce Examination Prevailed on 04.05.2022

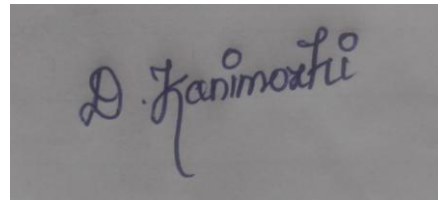
Internal Examiner

External Examiner

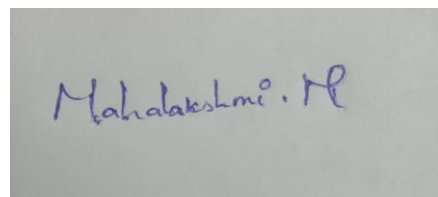
DECLARATION

We KANIMOZHI D (38130100) And MAHALAKSHMI M (38130124) hereby declare that the Project Report entitled **AUTOMATED CLASSIFICATION OF MRI BRAIN TUMOR USING DEEP NEURAL NETWORKS** done by us under the guidance of **MS.I. MARY SAJIN SANJU** is submitted in partial fulfillment of the wants for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

1.

A photograph of a handwritten signature in blue ink on a light-colored surface. The signature reads "D. Kanimozhi".

2.

A photograph of a handwritten signature in blue ink on a light-colored surface. The signature reads "Mahalakshmi. M".

DATE: 04.05.2022
PLACE: CHENNAI

SIGNATURE OF THE CANDIDATE

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ABSTRACT

The identification, segmentation and detection of infecting area in tumor MRI images are a tedious and time-consuming task. The various anatomy structure of figure will be visualized by a picture processing concepts. It's very difficult to possess vision about the abnormal structures of human brain using simple imaging techniques. Resonance imaging technique distinguishes and clarifies the neural architecture of human brain. MRI technique contains many imaging modalities that scans and capture the interior structure of human brain. During this study, we've targeting on noise removal technique, extraction of gray-level co-occurrence matrix features, DWT-based tumor region growing segmentation to cut back the complexity and improve the performance. This was followed by morphological filtering which removes the noise that may be formed after segmentation. The probabilistic neural network classifier was used to train and test the performance accuracy within the detection of tumor location in brain MRI images. The experimental results achieved nearly 100% accuracy in identifying normal and abnormal tissues from brain MR images demonstrating the effectiveness of the proposed technique.

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CHAPTER 1

INTRODUCTION

1.1 IMAGE PROCESSING:

Image processing could be a process during which we are able to enhance the information, Picture handling may be a cycle wherein we are able to upgrade the knowledge perceived from the sensors assail various sections of the life for various indicated application. While investigating the outcomes there's a rare change in quality because the items are obvious all the more plainly when contrasted with the initially detected picture. There are various advances related to the image preparing that addresses pictures, improvement of images, reproduction of images and film pressure. Picture preparing is an interaction wherein some tasks are acted in an exceedingly picture to urge the upgraded picture or getting some valuable data from it. Picture planning could be a variety of sign taking care of where the knowledge are given as a picture and also the yield are going to be a picture or qualities related with the knowledge picture. Nowadays picture handling may be a developing technologies. It structures center examination region inside software engineering disciplines and inside designing moreover.

1.1.1 Image processing has 3 steps:

- Image is imported from the image acquisition tool
- Analysis and manipulation is finished on image
- Output are going to be an altered image

1.2 KINDS OF IMAGE PROCESSING:

1. Analogue image processing
2. Digital image processing

1.2.1 1. ANALOGUE IMAGE PROCESSING:

In computing and applied science, analogue image processing may be a process which is performed on two-dimensional analog signals.

Analog image processing is opposite of digital image processing. The pictorial representation of an information within which it's represented as an analog waveform is termed as analog image. In older days television broadcasting through directional antenna system may be an example of analog image processing.

1.2.2 2. DIGITAL IMAGE PROCESSING:

Digital image processing could be a process of digital images using digital computers through an algorithm. Storing the info in digital form is named as digital image processing. Within the field of advanced sign preparing, computerized picture handling has more benefits over simple picture handling. During this interaction when an information is given it permits a large scope of calculations there to information picture.

By doing this, issues like development clamor and contortion will be decreased. In picture preparing since the images are two-dimensioned advanced picture handling can be demonstrated as multidimensional frameworks. Because of development of computers and development of math digital image processing is affected. The demand has increased .Example image data is stored in digital logic circuits.

1.3 IMAGE RESTORATION:

Restoration of image could be a process of reducing or reducing the degradation which is occurred during the acquisition of a picture. As an example, Noise, pixel value errors, out of focus blurring or camera motion blurring using prior knowledge of the degradation phenomenon. To reconstruct the image, it deals with the modeling of degradation so the process is applied. The image restoration possesses a large scope of usage.

The intention of image processing is “compensate for” or “undo” defects of a degraded image. Degradation refers to several forms like motion blur, noise, and camera miss focus. To revive the first image, estimate of the particular blurring function and “undo” the blur methods are possible in motion blur cases. In some cases, like where the image is corrupted by noise, the most effective thanks to do is to catch upon the degradation it caused. During this project, we'll introduce and

implement several of the methods employed in the image processing world to revive images. In some applications, noise may be removed effectively by sacrificing some resolution with image enhancement. During a fluorescence magnifying instrument, goal in the z-heading is awful all things considered. Further developed picture handling methods should be applied to recuperate the article.

The reason for picture rebuilding methods is to decrease recuperate goal misfortune and commotion. Picture handling strategies are performed either within the recurrence space or the image area. The clearest and a daily method for picture rebuilding is de convolution, which is acted within the recurrence space and within the wake of figuring the Fourier change of both the image and also the PSF and fix the goal misfortune let to by the obscuring factors. This de convolution procedure, thanks to its immediate reversal of the PSF which regularly has helpless framework condition number, enhances clamor and makes a flawed de blurred picture. Additionally, customarily the obscuring cycle is believed to be move invariant. Subsequently more refined methods, as an example, regularized de blurring are created to bring to the table hearty recuperation under various sorts of rumpus and obscuring capacities.

It is three types:

1. Geometric correction
2. Radiometric correction
3. Noise removal.

1.4 OBJECTIVES

- To detect and segment tumor region from the MRI images of brain.
- To conclude whether it's tumor image or not.
- To classify tumor as benign or malignant.
- To extract meaningful and accurate information from MRI images with least error possible.
- To reduce the false positive and false negative rate and cancer patients are diagnosed in additional accurate way.

CHAPTER 2

LITERATURE SURVEY

Analyzing and processing of MRI tumor images are the foremost challenging and upcoming field. Resonance imaging (MRI) may be a complicated medical imaging technique accustomed produce high-quality images of the parts contained within the chars is and it is vital process for deciding the proper therapy at right for tumor-infected individual.

Many techniques are proposed for classification of brain tumors in MR images like fuzzy clustering means support vector machine ,artificial neural network (ANN), knowledge-based techniques, and expectation-maximization (EM) algorithm technique which are variety of favored techniques used for region-based segmentation then to extract the important information from the medical imaging modalities.

BAHADURE et al. proposed Burrows Wheeler Transform and Support Vector Machine techniques image analysis for MRI-based tumor detection and classification, During method, accuracy of 95% was achieved using skull stripping which eliminated all non-brain tissues for the detection purpose [1]. Joseph et al. [2] proposed segmentation of MRI brain images using *K*-means clustering algorithm along with the morphological filtering for the detection of tumor images. The automated tumor classification of MRI images using support vector machine was proposed by Alphonse and Salem [3]. The accuracy of a classifier was improved using fast transform for the extraction of features and minimal redundancy maximal relevance technique was used for reduction of features. The accuracy obtained from the proposed work is 98%.

The brain MRI image contains two regions which are to be separated for the extraction of tumor regions. One an element of region contains the tumor abnormal cells, whereas the second region contains the standard brain cells [4]. For the tumor segmentation, Fares [5] proposed an approach supported hybrid type, with the combination of seed growing, Fuzzy C-Means, and Jaccard similarity coefficient

algorithm with the measure of grey and white segmented tissue from tumor images. A mean score of S of 90% segmentation was achieved with amplitude of 9–3%.

To manage and to pander to protocols of assorted images and non linearity of real data a decent classification supported contrast of enhanced MRI images, Yao et al. [6] proposed an methodology including extraction of textures features with wavelet transform and Support Vector Mechanism with an accuracy of 83%. For the classification and tumor segmentation, Kumar and VIJAYAKUMAR [7] proposed methodology using principal component analysis (PCA) and radial basis function kernel with Support Vector Mechanism. They got an accuracy of 94% with the method. An non natural neural network tool as both classifier and segmentation was used for the effective classification of brain tumor from MRI images was proposed by Sharma et al. [8] with the utilization of textural primitive features which achieved an accuracy of 100%.

For the medical image segmentation, a localized fuzzy clustering with the extraction of spatial information was proposed by Cui et al. [9]. The author used Jaccard similarity index as a measure of segmentation claiming an accuracy of 83–95% and differentiating in to white, gray and humor.

For the tumor image segmentation, active contour method was applied to unravel the matter supported intensity homo genetics on MRI images was proposed by Wang et al. [10]. For the automated extraction of features and tumor detection a with an enhanced feature using Gaussian mixture model applied on MRI images with wavelet features and principal component analysis was proposed by Chad dad [11] with an accuracy of Technique 1- weighted 95% and Technique 2- weighted 92% for FLAIR MRI weighted images.

The author SACHDEVA et al. [11] used a synthetically neural network and PCA–ANN for the multiclass tumor MRI images classification, segmentation with dataset of 428 MRI images and an accuracy of 75–90% was achieved.

The literature survey above gives a transparent view of the techniques that were invented only to induce the segmentation—region of interest, some techniques for extracting features and some to teach and test using the classifiers for classification

only. Much effective segmentation with the combined feature extraction couldn't be conducted, and only few features were extracted which resulted in low accuracy in tumor identification and detection. The classifiers accustomed train the features are not much effective.

In this paper, we have got combined discrete wavelet transformation (DWT) with the extraction of textural and Gray Level Co-occurrence Matrix features followed by morphological operations with probabilistic neural network as a classifier tool. The study deals with the extraction of features from the segmented region to detect and classify the normal and abnormal tumor cells of medical brain MRI images for an outsized database. Our outcome ends up in conclusion that with this proposed method it makes clinical experts easy to want a choice regarding diagnosis and also scanning.

CHAPTER 3

AIM AND SCOPE

3.1 AIM OF THE PROJECT

Aim of presenting this paper is to detect the tumor by using thresholding and watershed algorithm. So on search out the proper size, shape, limit extraction and area of tumor identification are helpful. To detect and segment tumor there are three stages. For detection of tumor supported segmentation there's an efficient algorithm. For detection of tumor in scanned image, firstly, enhancement process of scanned image and morphological operators are applied. Once edges are detected. Operators are applied therefore the boundaries is extracted and also the scale of tumor are going to be found.

Keywords — Brain Tumor, MRI, Segmentation.

The brain may be a fragile, sensitive, irreplaceable and lightweight tissue. It is a gentle place for examples to enter and settle among one another. A tumor is essentially a swelling of a component of the body that becomes a wild force that governs the everyday forces of its development. Tumor could also be a gathering of irregular cells that becomes either inside the mind or on the other hand around the brain. All healthy brain cells is also destroy by tumors. It can indirectly, adversely harm the healthy brain cells by swarming into different parts of the brain and causing aggravation, brain swelling and inducing pressure inside the skull.

Exact measurements in tumor diagnosis are very troublesome due to assorted shapes, sizes and tumor appearance. Tumors may develop unexpectedly, leading to adjacent additionally, the organization also provides an outsized number of bizarre structures for solid tissue. During this paper, we are visiting use a division related to morphological activities to see a three-dimensional segmentation process for brain tumors.

3.2 TYPES OF TUMOR

Tumor

Tumor is additionally termed as 'Neoplasm'. Tumors are completely unexpected cancers.

Tumors are of three types:-

- 1) Benign (Non- Cancerous)
- 2) Pre-Malignant
- 3) Malignant (Cancerous)

3.2.1 BENIGN(Non-Cancerous)

Benign tumor is also a mass of cells that forms a lump, which lacks the ability to invade the Neighbouring tissues or spread to other Non-Neighbouring parts of the body. These tumor have how slower rate and thus, they are fearless risky. Benign brain tumors can usually be successfully removed with surgery and don't usually grow back. Warts are a standard condition of benign tumors.

3.2.2 PRE-MALIGNANT TUMOR

Premalignant Tumor is that the precancerous stage of tumor and is taken into consideration a disease that will cause cancer if not treated properly.

3.2.3 MALIGNANT TUMOR

Malignant is that the type of tumor that grows over time and eventually the results of the tumor is death. A malignant disease is really a medical term describing an important disease. Malignant tumors are the terms that are often used to describe tumors.

Magnetic Resonance Imaging (MRI)

Magnetic resonances imaging (MRI), [also brought up as, Resonance Tomography (MRT), Nuclear MRI is also a medical imaging method employed in radiology to seem closely at images of the inside structure of the body.

MRI utilizes three electromagnetic fields: the electrical field, which is an especially robust static attraction field that energizes the hydrogen nucleus; the gradient field can be a more fragile time-shifting field for spatial coding; and is employed to control the hydrogen nucleus. A weak RF field that provides a measurable signal is collected through the Often antenna.

This procedure is particularly accustomed distinguish between the differences within the tissues which have a evidently better strategy compared to computer tomography. Hence, this makes this a rare procedure for the identification of tumor and cancer imaging.

3.3 EXISTING METHOD AND PROPOSED SYSTEM

3.3.1 EXISTING METHOD

Fusion based: Overlapping the brain image of the victim over a test image of same people thereby detecting the tumor

Demerits

- The overlapping creates complexity due to different dimensions of both images
- Time consuming process

Canny based: To overcome the matter of detecting the edges, the upper way is that the utilization of canny based edge detection.

Demerits

- Not supporting color images
- This finally ends up in increase in time to achieve the optimal solution.

3.3.2 PROPOSED SYSTEM

- First the MRI brain image is taken as an input for preprocessing system.
- System will classify there's tumor or not. if there's tumor image will go choose segmentation part.
- DNN algorithms applied on output image and tumor part are visiting be segmented.
- If there is no tumor then directly it'll indicate normal brain.

3.4 BLOCK DIAGRAM

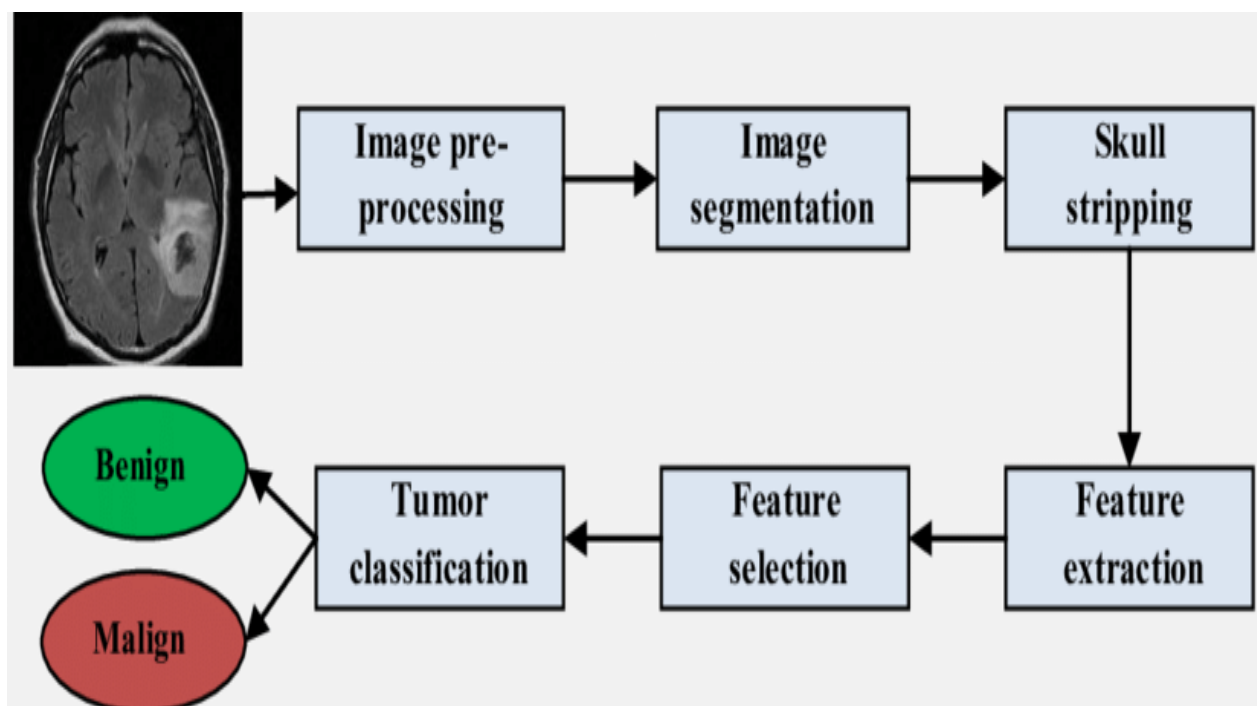


Fig 3.1 BLOCK DIAGRAM

The Software component required in the proposed method is MATLAB.

CHAPTER 4

EXPERIMENTAL SETUP AND IMPLEMENTATION OF PROJECT

4.1 MATLAB:

MATLAB may be a programming and numeric registering stage utilized by a good many specialists and researchers to look at information, create calculations, and make models. MATLAB is meant for the style during which you think that and also the work you are doing.

MATLAB consolidates a piece of area climate tuned for iterative investigation and configuration measures with a programming language that communicates lattice and cluster science straightforwardly. It incorporates the Live Editor for creating contents that consolidate code, yield, and arranged content in an executable scratch pad.

4.1.1 PROFESSIONALLY BUILT:

MATLAB tool boxes are professionally developed, rigorously tested, and fully documented.

4.1.2 WITH INTERACTIVE APPS:

MATLAB apps allowed you to see how different algorithms work along with your data. Iterate until you've got the results you wish, then automatically generate a MATLAB program to breed or automate your work.

4.1.3 ABILITY TO SCALE:

Scale your analyses for run on clusters, GPUs and clouds with only the minor code changes. There's no must rewrite your code or learn big data programming and out-of-memory techniques.

4.1.4 USED FOR:

MATLAB may be a programming platform designed specifically for engineers and scientists to analyze and style systems and products that transform our world.

The heart of the MATLAB is the MATLAB language. A matrix-based languages are allowing the most natural expression of computational mathematics.

4.2 DATA BASE COLLECTIONS:

Database collection is understood as collection of knowledge. During this proposed work first step is collecting the initial images. The images has been collected directly from the net. The photographs collected are showed below. The photographs are within the kind of some aging factors. The most aim of this proposed work is to get rid of these degradations within the image and filling the approximate alter it. This may be done by using in painting technique.

MATLAB could be a high-performance language for the technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar notational system. Typical uses include:

- Math and computation
- Algorithm development
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including Graphical User program building

MATLAB is an interactive system. It's basic data element is an array that does not requires dimensioning. This permits you to unravel many technical computing problems, especially those with matrix and vector formulations, in an exceedingly fraction of the time it might desire write a program during a scalar non interactive language like as C.

The name MATLAB stands for matrix laboratory. MATLAB was originally written to produce quick access to matrix software developed by the LINPACK and EISPACK projects, which together represent the state-of-the-art in software for matrix computation.

MATLAB evolved over a periods of years with input from more users. In university environments, it's the quality instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is that the tool of choice for high-productivity research, development, and analysis.

MATLAB's family of application specific solutions are tool boxes. Important to most users of MATLAB, toolboxes allow you to find out and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that reach the MATLAB environment to resolve particular classes of problems. Areas during which toolboxes are available include signal processing, control systems, neural networks, mathematical logic, wavelets, simulation, and lots of others.

4.3 The MATLAB System

MATLAB consists of five main parts:

The MATLAB language.

This is a high level of matrix or array language with a control flow statements, functions, data structures, input or output and object-oriented programming features. MATLAB allows both "programming within the small function" to rapidly create quick and dirty throw-away programs, and "programming within the large function" to make complete large and sophisticated application programs.

The MATLAB working environment.

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

Handle Graphics.

This is the MATLAB graphics system. It includes high level comments for two dimensional and also for three-dimensional data visualization, image processing, animation and presentation graphics. It also includes low-level commands that allow you to completely customize the looks of graphics additionally on build complete Graphical User Interfaces on your MATLAB applications.

The MATLAB function library.

This is an unlimited collection of computational algorithms starting from elementary functions like sum, sine, cosine, and sophisticated arithmetic, to more sophisticated functions like matrix inverse, matrix eigenvalues, Bessel functions, and fast Fourier transforms.

The MATLAB Computer Program Interface (API).

This is a library that permits you to jot down C and FORTRAN programs that interact with MATLAB. It includes the facilities for call routines from MATLAB (dynamic linking), calling MATLAB as a computational engine and for reading and writing MAT-files.

4.3.1 MATLAB Power of Computational Mathematics

MATLAB is employed in every facet of computational mathematics. Following are some commonly used mathematical calculations where it's used most ordinarily –

1. Dealing with Matrices and Arrays
2. 2-D and 3-D Plotting and graphics
3. Linear Algebra
4. Algebraic Equations
5. Non-linear Functions
6. Statistics
7. Data Analysis

8. Calculus and Differential Equations
9. Numerical Calculations
10. Integration
11. Transforms
12. Curve Fitting
13. Various other special functions

4.3.2 FEATURES OF MATLAB

Following are the essential features of MATLAB –

- It is a problem-oriented language for numerical computation, visualization and application development.
- It also provides interactive environment for the iterative exploration, design and problem solving.
- It provides vast library of mathematical functions for 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 programming interface gives development tools for improving code quality maintainability and maximizing performance.
- It provides the tools for many building applications with the custom graphical interfaces.
- It provides functions for integrating MATLAB based algorithms with external applications and languages like C, Java, .NET and Microsoft Excel.

4.3.3 USES OF MATLAB

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and every engineering streams. It's utilized in a spread of applications including –

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

- Test and Measurement
- Computational Finance
- Computational Biology

4.3.4 LOCAL ENVIRONMENT SETUP

Setting up MATLAB environment may be a matter of few clicks. The installer are often downloaded from here.

MATLAB Works provides the licensed product, a short version and a student version additionally. You would like to log into the location and wait a touch for his or her approval.

After downloading the installer, the software may be installed through few clicks

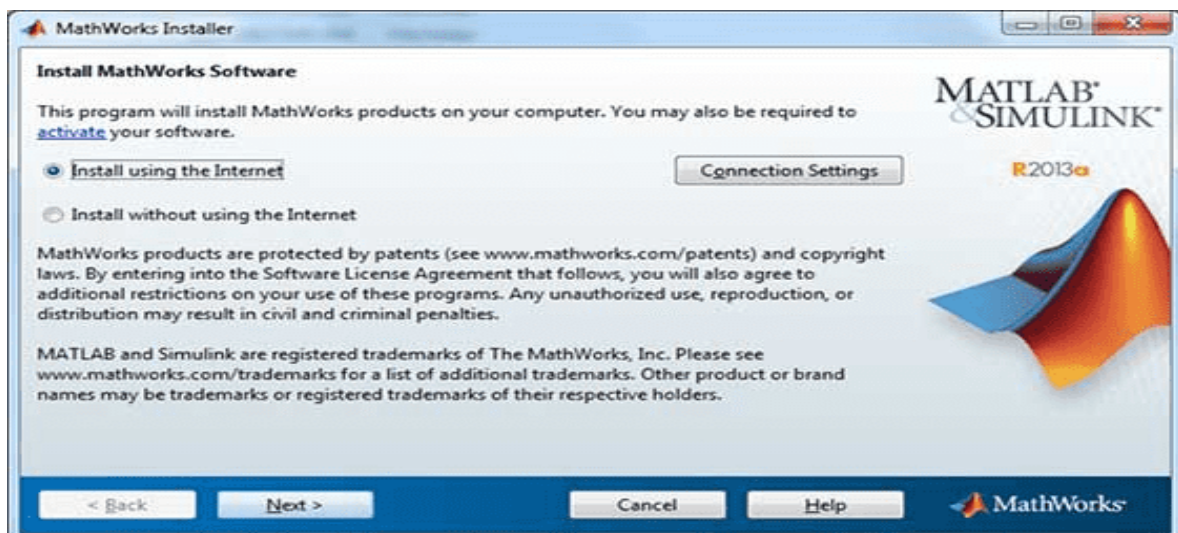


Fig 4.1 MATLAB install page

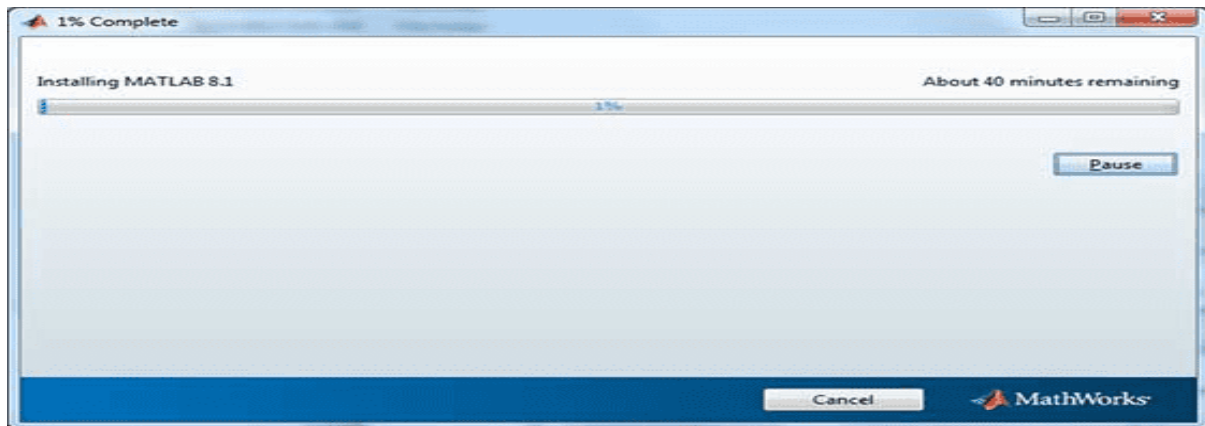


Fig 4.2installing page

4.3.5 UNDERSTANDING THE MATLAB ENVIRONMENT

MATLAB development IDE will be launched from the icon created on the desktop. The most working window in MATLAB is termed the desktop. When MATLAB is start the program, the desktop appears in the default layout –

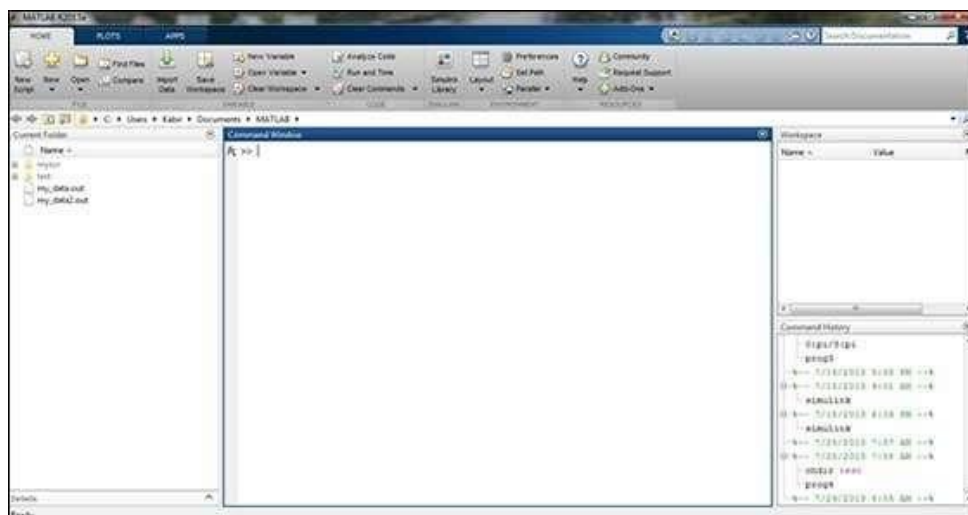


Fig 4.3MATLAB window

The desktop has the subsequent panels .

- **Current Folder** – This panels are allows you to access the project folders and files.



Fig 4.4 Folder Page

- **Command Window** – This is often the most area where commands can be entered at the program line. It's indicated by the electronic communication (>>).

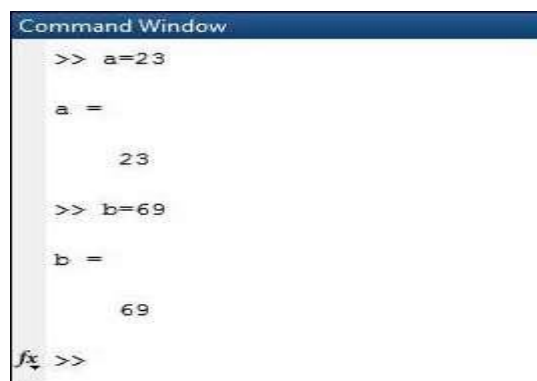


Fig 4.5 Command Window

- **Workspace** – The workspace shows all the variables created and/or imported from files.

Workspace	
Name ▲	Value
a	23
b	69

Fig4.6Workspace

- **Command History** –This panel shows or return commands that are entered at the program line.

```

$-- 7/14/2013 5:58 PM --$
$-- 7/15/2013 9:01 AM --$
simulink
$-- 7/15/2013 6:09 PM --$
simulink
$-- 7/25/2013 7:57 AM --$
$-- 7/25/2013 7:58 AM --$
chdir test
prog4
$-- 7/29/2013 8:55 AM --$
a=23
b=69

```

Fig 4.7Program Window

SET UP GNU OCTAVE

If you're willing to use Octave on your machine (Linux, BSD, OS X or Windows), then kindly download latest version from Download GNU Octave. You'll check the given installation instructions for your machine.

4.3.6 THE M FILES

MATLAB allows writing two forms of program files –

Scripts – script files are the program files with .m extensions. In these files, you write series of commands, which you would like to execute together. Scripts don't accept inputs and don't return any outputs. They operate on data within the workspace.

Functions – functions files are program files with .m extension. Functions can accept inputs and return outputs. Internal variables are the local for the functions.

You can use the MATLAB editor or the other text editor to make you. MATLAB files. During this section, we'll discuss the script files. A script file contains multiple sequential lines of MATLAB commands and performance calls. You'll be able to run a script by typing its name at the statement.

4.3.7 APPLICATIONS OF MATLAB

MATLAB will be used as a tool for simulating various electrical networks but the recent developments in MATLAB make it a awfully competitive tool for AI, Robotics, Image processing, Wireless communication, Machine learning, Data analytics and whatnot. Though it's mostly employed by circuit branches and mechanical within the engineering domain to resolve a basic set of problems its application is vast. It's a tool that permits computation, programming and graphically visualizing the results.

The basic data element of MATLAB because the name suggests is that the Matrix or an array. MATLAB toolboxes are professionally built and enable you to show your imaginations into reality. MATLAB programming is kind of almost like C programming and just requires a touch brush from your basic programming skills to begin working with.

Below are some applications of MATLAB –

Statistics and machine learning (ML)

This toolbox in MATLAB will be very handy for the programmers. Statistical methods like as descriptive or inferential will be easily implemented. So is that the case with machine learning. Various models will be employed to unravel modern-day problems. The algorithms used may be used for giant data applications.

Curve fitting

The curve fitting toolbox helps to analyze the pattern of occurrence of information. After a selected trend which might be a curve or surface is obtained, its future trends will be predicted. Further plotting, calculating integrals, derivatives, interpolation, etc., may be done.

Control systems

Systems nature may be obtained. Factors like closed-loop, open-loop, its controllability and observability, bode plot, nyquist plot, etc will be obtained. Various controlling techniques like PD, PI and PID may be visualized. Analysis are often wiped out the time domain or frequency domain.

Signal Processing

Signals & systems and digital signal processing are taught in various engineering streams. But MATLAB provides the chance for correct visualization of this. Various transforms like Laplace, Z, etc. is done on any given signal. Theorems will be validated. Analysis may be drained the time domain or frequency domain. There are multiple built-in functions that may be used.

Mapping

Mapping has multiple applications in various domains. For instance, Big data, the Map Reduce tool is sort of important which has multiple applications within the world. Theft analysis or financial fraud detection, regression models, contingency analysis are the predicting techniques in social media. Data monitoring etc. will be done by the data mapping.

Deep learning

It's a subclass of machine learning which may be used for speech recognition, financial fraud detection, medical image analysis. Tools like time-series, Artificial neural network (ANN), mathematical logic or combination of such tools is employed.

Financial analysis

An entrepreneur before starting any endeavor must do a correct survey and therefore the financial analysis so as to plan the course of action. The tools needed for this are available in MATLAB. Elements like profitability, solvency, liquidity, and stability is identified. Business valuation, capital budgeting, cost of capital, etc will be evaluated.

Image processing

The most common application that we observe almost a day are code scanners, selfie (face beauty, blurring the background, face detection), image enhancement, etc. The digital image processing also plays quite important role in transmitting data from remote satellites and receiving and decoding it within the same way.

Text analysis

Based on the text, sentiment analysis will be done. Google gives several search results for any text entered within some milliseconds. All this is often possible because of text analysis. Handwriting comparison in forensics can be done. No limit to the appliance and only one software which might do this all.

4.4 PREPROCESSING:

Pre-processing could be a typical name for tasks with pictures at the foremost minimal degree of deliberations both info and yield are force pictures. These notorious pictures are of an analogs kind because the first information caught by the sensor, with a force picture typically addressed by a grid of picture work esteems (brightness). The purpose of pre-handling is an improvement of the image information that suppresses undesirable bends or upgrades some picture highlights significant for extra preparing albeit mathematical changes of images (for example pivot, scaling, interpretation) are ordered among pre-handling strategies here since comparable procedures are utilized.

Picture pre-handling may have emotional beneficial outcomes on the character of highlight extraction and also the consequences of picture examination. Picture pre-handling is akin to the numerical standardization of an informational index, which could be a typical advance in many element descriptor techniques. Or on the opposite hand to create a melodic similarity, consider picture pre-processing as a sound framework with a scope of controls, for instance, crude sound with no volume controls; volume control with a basic tone handle; volume control additionally to high frequency, bass, and mid; or volume control additionally to a full design's equalizer, impacts handling, and extraordinary speakers in an acoustically unrivaled room. In this manner, this section advances picture pre-handling by portraying a mixture of rectifications and enhancements that are a fundamental piece of a PC vision pipeline.

Picture pre-processing strategies utilize the many excess in pictures.

Adjoining pixels referring to one item in genuine pictures have basically something similar or comparative brilliance esteem, so if a mutilated pixel will be chosen from the image, it can for the foremost part be reestablished as a traditional good thing about adjoining pixels. Picture pre-processing techniques are characterized into four classes as indicated by the scale of the pixel neighborhood that's utilized for the count of another pixel splendor. Which are manages pixel brilliance transformations, describes mathematical changes, considers preprocessing strategies that utilization a close-by neighborhood of the handled pixel and momentarily portrays picture rebuilding that requires information about the entire picture.

4.5 FILTERING PROCESS:

To reestablish an image from straight debasement different channels are utilized like opposite, pseudo reverse, wiener channel and visually impaired de-convolution are utilized in several methods. Picture rebuilding is the activity of taking an adulterated or loud picture and gauge the clean of the primary picture. Sifting could be a strategy for changing or upgrading an image. For example, you'll be able to channel an image to fret certain highlights or eliminate different highlights. Picture preparing activities dispensed with separating incorporate smoothing, honing, and edge upgrade.

In picture preparing channels are essentially accustomed stifle either the high frequencies within the picture, i.e., smoothing the image, or the low frequencies, i.e., improving or distinguishing edges within the picture. An image is separated either in the recurrence or within the spatial area.

4.6 SEGMENTATION:

The first piece of picture preparing is picture division. Current division approaches are reviewed with a complement placed on revealing the benefits and inconveniences of those procedures for clinical imaging applications. Manual division of clinical picture by the radiologist isn't only a drawn-out and drawn-out cycle, yet moreover not exact especially with the extending clinical imaging modalities and unmanageable number of clinical pictures that should be reviewed. It winds up being thus critical to review current methods of picture division using automated computations that are exact and want as little customer coordinated effort as possible especially for clinical pictures.

In advanced picture handling and PC vision, picture division is that the strategy for parceling a computerized picture into various fragments (sets of pixels, furthermore called picture objects). The target of division is to vary additionally as adjustment the delineation of a picture into one thing that's a lot of considerable and simpler to research. Picture division is often acclimated discover articles and limits (lines, bends, so on) in pictures. a good deal of precisely, picture division is that the technique for task a mark to each constituent in a picture indicated pixel with steady name share sure attributes.

The end result of picture division may be a lot of areas that everything considered cover the entire picture, or plenty of structures isolated from the image (see edge revelation).All of the pixels in a locality are similar with regard to some reserve or handled property, similar to tone, force, or surface. Handy zones are basically interesting with relevance the comparable characteristic(s). Right when applied to a heap of images, ordinary in clinical imaging the resulting shapes after picture division are often accustomed make 3Dmultiplications with the assistance of expansion estimations like strolling 3D squares.

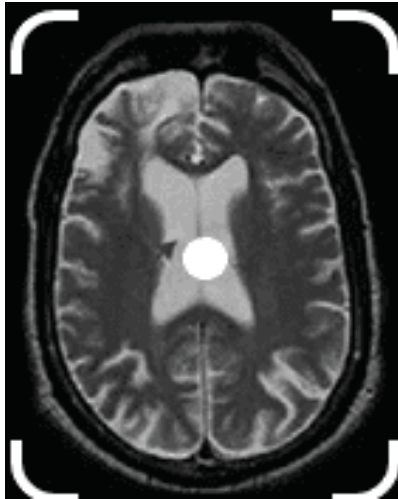


Fig 4.8Input Image 1

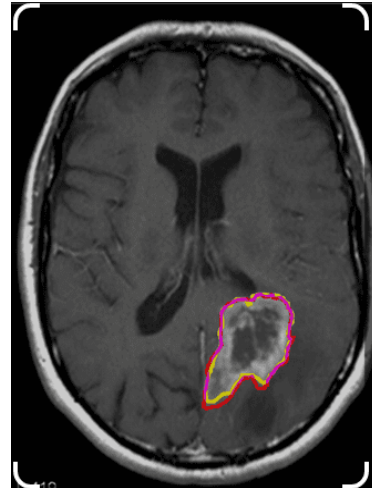


Fig 4.9Segmented Image1

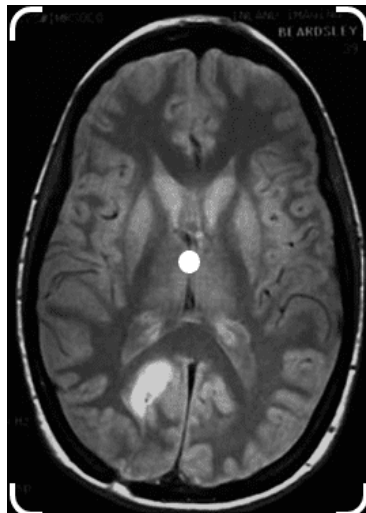


Fig 4.10Input Image 2

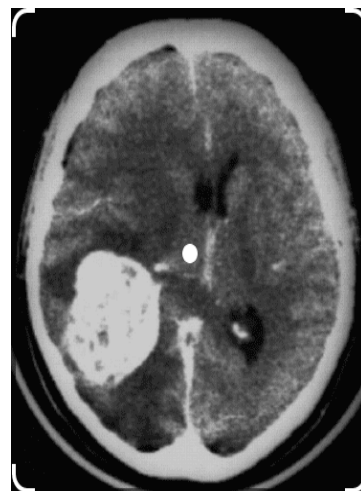


Fig 4.11Segmented Image 2

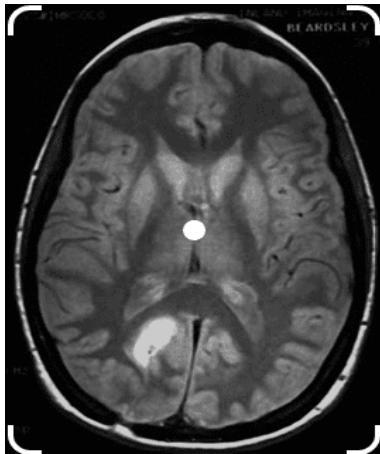


Fig 4.12Input Image 3

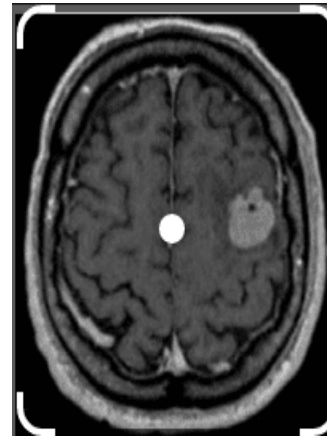


Fig 4.13 Segmented Image 3

4.7 THRESHOLD SEGMENTATION:

Threshold segmentation is that the supported an easy segmentation technique where we input image called the grey scale image is first converted into a binary format.

This segmentation method is meted out on a threshold value which varies as per the features of the grey scale image while being converted into a binary image format. The choice of a threshold value for segmentation, is that the prime concern. Image utilizing histogram helps us to find one threshold value for the identical. Image Utilizing Histogram could be a style of histogram that's based as a graphical representation for the tonal distribution in an exceedingly advance picture. The number of pixels for every tonal value is plotted on the histogram.

Watershed segmentation:-

Watershed segmentation is extraordinary, compared to other strategies for collecting image pixels supported their intensity. Pixels at the identical intensity are combined, which eases the segmentation procedure in order that we will isolate a tumor from the image. Watershed could be a scientific morphological working tool.

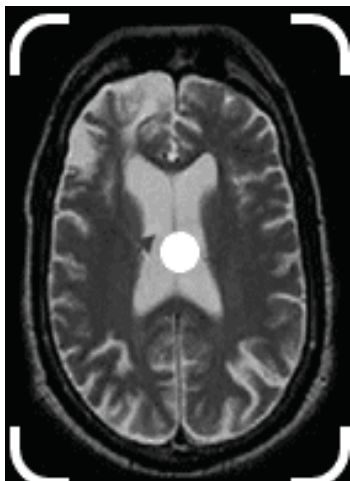


Fig 4.14Input Image 1



Fig 4.15Threshold Image 1

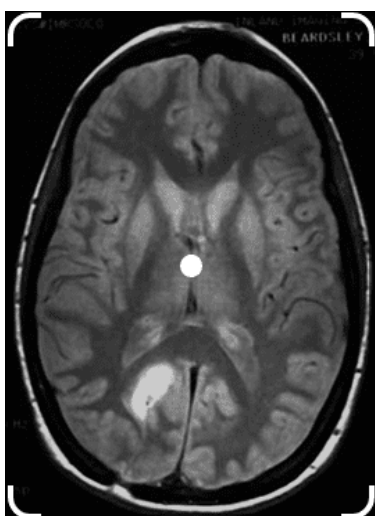


Fig 4.16Input Image 2

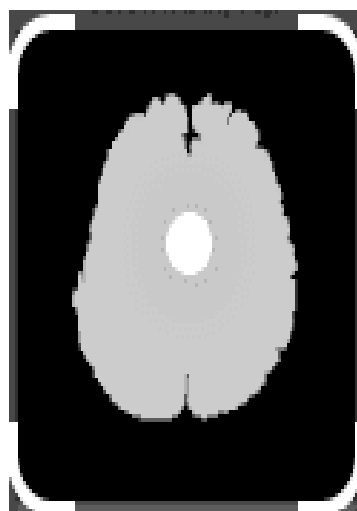


Fig4.17Threshold Image 2

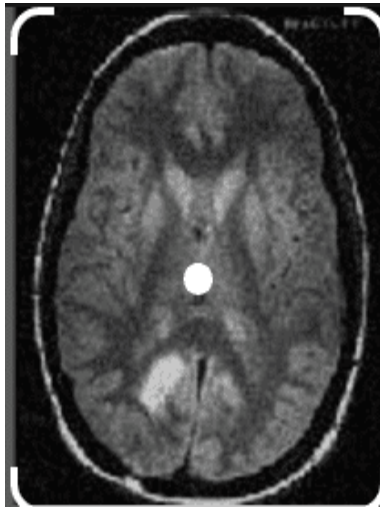


Fig 4.18INPUT IMAGE 3

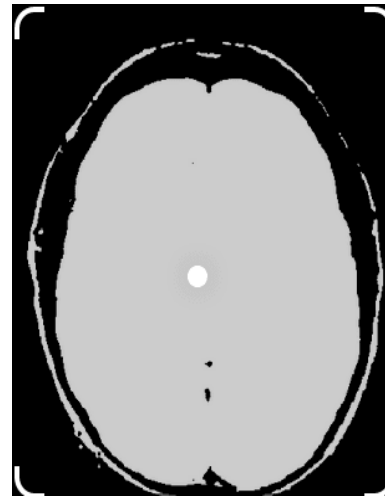


Fig4.19THRESHOLD IMAGE 3

4.8 ACCURACY

Within the study of image processing the term "accuracy" means a measure of consistency with reliable information during a spatial point with data on the classified image.

Sl. no	Accuracy
1	90.90
2	90.92
3	90.94
4	90.96
5	90.97
6	90.98
7	90.99

4.9 Detection of Tumor

After having performed the segmentation procedure by any of the above mentioned method, be it watershed or the edge, we are left with the foremost awaited part on which we want to figure which is that the tumor. This bit contains just high exceptional pixels which appears thoroughly its white part.

Extraction of Boundary in Tumor

Edge-based segmentation is that the most generally accepted technique, which depends on the invention of edges, ie the separation of various regions.

Shape and Size of Tumor

Once we've the boundary of the tumor, shape of the tumor can easily be decided. If we getting round boundary then its shape is roundabout and then on.

After that we are finding the dimensions of the tumor, it's Estimated within the matrix form ($m \times n$).

4.10 Feature extraction using Gray Level Co-occurrence Matrix

Texture analysis differentiates normal and abnormal tissues easily for human beholding and machine learning. It also provides variation between malignant and normal tissues, which cannot be visible to human eye. It improve the accuracy by choosing the effective quantitative features for early diagnosis. Within the opening move, the first-order statistical textural analysis-features information from the histogram of image intensities was extracted and frequencies of gray level at a random image positions were measured. It doesn't consider correlation or co-occurrences, between pixels. Within the second step, the second-order textural analysis-features were extracted supported probability of gray levels haphazardly distances and over entire image orientations.

The statistical features were extracted using gray-level co-occurrence matrix, also known gray-level spatial dependence matrix. Gray Level Co-occurrence Matrix was introduced by Haralick [17]. It's an approach that describes the relation between pixels of assorted gray-level values [15]. Gray-level co-occurrence matrix is 2D histogram during which (p, q) th elements is that the frequency of event p occurs with q . It's a function of distance $S = 1$, angle (at 0 (horizontal), 45° (with the positive diagonal), 90° (vertical) and 135° (negative diagonal) and grey scales p and q , and calculates how often a pixel with intensity p , occurs in relation with another pixel q at a particular distance S and orientation. In this method, gray-level co-occurrence matrix was initiated and therefore the textural features like contrast, correlation, energy, homogeneity, entropy and variance were obtained from LL and HL sub-bands of first four levels of wavelet decomposition [18]. The textural features extracts are listed below:

Contrast Measurement of pixels intensities and its neighboring above images are given by the equation:

$$CONT = \sum_{x=0}^{m-1} \sum_{y=0}^{n-1} (x-y)^2 f(x, y) \text{ ----- (2)}$$

Energy defines the quantitative amounts of the repetitive pixel pairs. It's the measurement of affinity in a picture, given by equation:

$$ENG = \sum_{p=0}^{i-1} \sum_{q=0}^{j-1} f^2(p, q) \text{ ----- (3)}$$

Correlation is the measurement of the spatial features dependencies between the pixels.

$$COR = \sum_{i=1}^M \sum_{p=0}^{i-1} \sum_{j=1}^M \sum_{q=0}^{j-1} (p, q) f(p, q) - \frac{M_p M_q \sigma_p \sigma_q}{M^2} \text{ ----- (4)}$$

Homogeneity (HOM) Measurement of local uniformity in a picture. It's also called as inverse difference moment and contains a one or more range of values to differentiate between textured and non-textured.

$$HOM = \sum_{p=0}^{i-1} \sum_{q=0}^{j-1} 1 + (p-q)^2 f(p, q) \text{ ----- (5)}$$

Entropy is calculates the designated interference of the textual image. It's given as:

$$ENT = - \sum_{p=0}^{i-1} \sum_{q=0}^{j-1} f(p, q) \log_2 f(p, q) \text{ ----- (6)}$$

After the textural features extraction, the subsequent features assessment parameter are required to be obtained for better analysis on brain MRI images.

Peak S/N Is a measure use to evaluate the characteristic features of reconstructed image from processed image. It's given as:

$$\text{Peak Signal to Noise Ratio} = 20 \log_{10} \frac{2m-1}{MSE} \text{ ----- (7)}$$

Lower the worth of mean square error and better value of peak Signal/Noise indicate better S/N.

Mean Square Error is the measure of fidelity of signal or image. It absolutely was accustomed compare two images by giving quantitative or similarity scores.

$$MSE = \frac{1}{P \times Q} \sum \sum (f(i, j) - f_R(i, j))^2 \text{ ----- (8)}$$

These extracted statistical features were fed into probabilistic neural network classifier as an input for training and testing the performance of classifier within the classification of brain tumor images into normal and abnormal.

4.11 Skull Stripping

Skull stripping is a crucial process in biomedical image analysis, and it's required for the effective examination of tumor from the MR images [25–28]. Skull stripping is that the process of eliminating all non-brain tissues within the brain images. By skull stripping, it's possible to get rid of additional cerebral tissues like fat, skin, and skull within the brain images. There are several techniques available for skull stripping; a number of the popular techniques are automatic skull stripping using image contour, skull stripping supported segmentation and morphological operation, and skull stripping supported histogram analysis or a threshold value. Figure 2 provides the stages of skull stripping algorithm. This study uses the skull stripping technique that's supported operation to get rid of skull tissues.

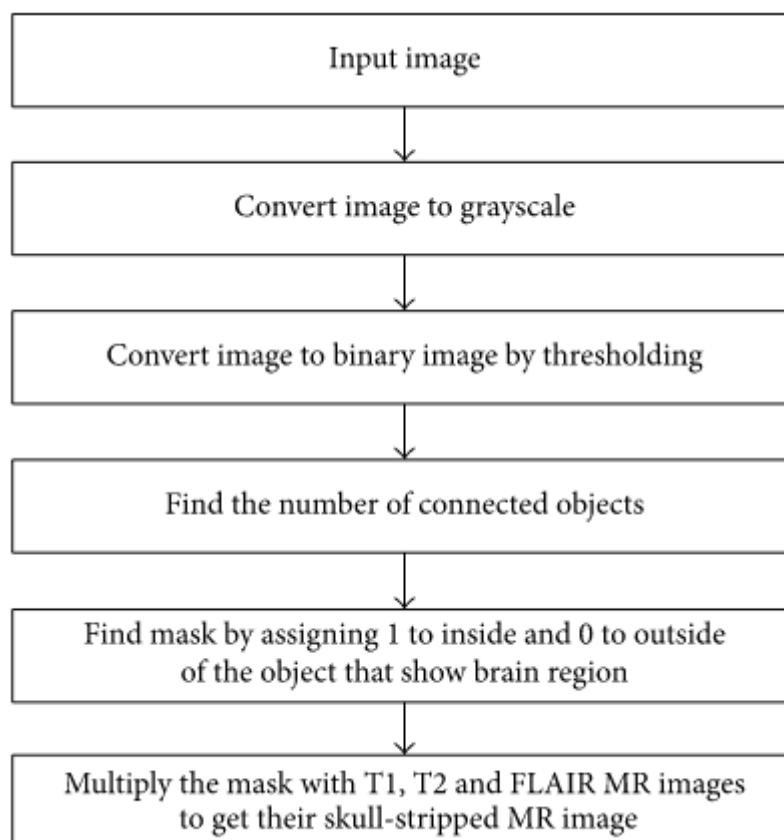


Fig 4.20 SKULL STRIPPING ALGORITHM

4.12 FEATURE EXTRACTION

Feature extraction may be a part of the dimensionality reduction process, in which, an initial set of the data is split and reduced to more manageable groups. So, after you want to process it'll be easier. The foremost important characteristic of those large data sets is that they need an oversized number of variables. These variables require a lots of computing resources to process. So Feature extraction helps to induce the simplest feature from those big data sets by selecting and mixing variables into features, thus, effectively reducing the number of knowledge. These features are easy to process, but still ready to describe the particular data set with accuracy and originality.

The technique of extracting the features is beneficial after you have an outsized data set and want to cut back the quantity of resources without losing any important or relevant information. Feature extraction helps to scale back the number of redundant data from the information set.

In the end, the reduction of the info helps to create the model with less machine effort and also increases the speed of learning and generalization steps in the machine learning process.

Applications of Feature Extraction

- **Bag of Words- Bag-of-Words** is that the most used technique for language processing. During this process they extract the words or the features from a sentence, document, website, etc. and so they classify them into the frequency of use. So during this whole process feature extraction is one in all the foremost important parts.
- **Image Processing** –Image processing is one amongst the most effective and most interesting domain. During this domain basically you may start wiggling with your images so as to know them. So here we use many techniques which

incorporates feature extraction additionally and algorithms to detect features like shaped, edges, or motion in a very digital image or video to process them.

- **Auto-encoders:** The main purpose of the auto encoders is the efficient data coding which is unsupervised in nature. This process comes under unsupervised learning. So Feature extraction procedure is applicable here to spot the key features from the information to code by learning from the coding of the initial data set to derive new ones.

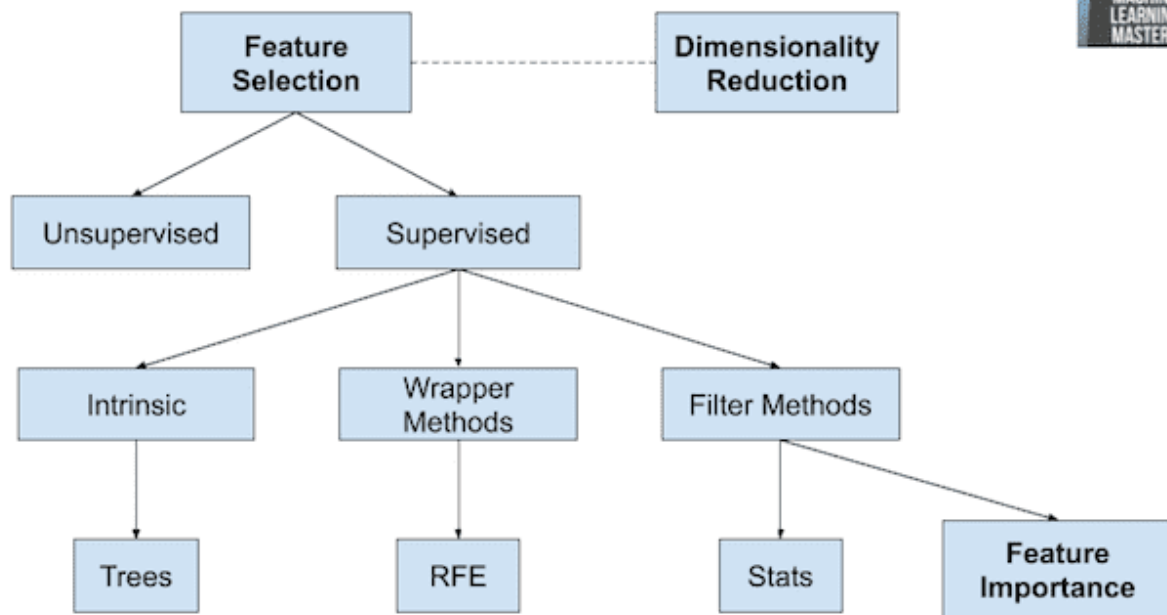
4.13 FEATURE SELECTION

Feature selection is that the process of reducing the quantity of input variables when developing a predictive model. It's desirable to scale back the quantity of input variables to both reduce the computational cost of modeling and, in some cases, to boost the performance of the model. Statistical-based feature selection methods involve evaluating the link between each input variable and therefore the target variable using statistics and selecting those input variables that have the strongest relationship with the target variable. These methods will be fast and effective, although the selection of statistical measures depends on the information sort of both the input and output variables.

As such, it will be challenging for a machine learning practitioner to pick an appropriate statistical measure for a dataset when performing filter-based feature selection.

- There are two main forms of feature selection techniques: supervised and unsupervised, and supervised methods is also divided into wrapper, filter and intrinsic.
- Filter-based feature selection methods use statistical measures to get the correlation or dependence between input variables that may be filtered to settle on the foremost relevant features.
- Statistical measures for feature selection must be carefully chosen supported the info kind of the input variable and also the output or response variable.

Overview of Feature Selection Techniques



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Fig 4.21 Overview of Feature Selection Techniques

CHAPTER 5

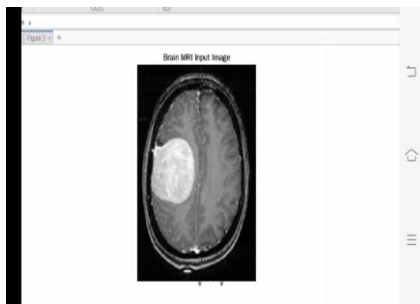
RESULT AND DISCUSSION

RESULTS

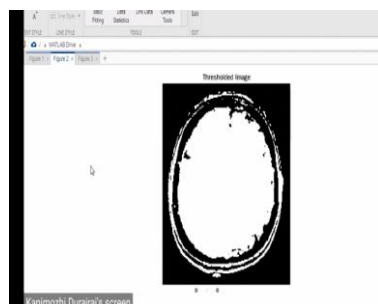
OUTPUT IMAGES

BENIGN(+):

Input Image 1



Threshold Image1



Segmented Image1

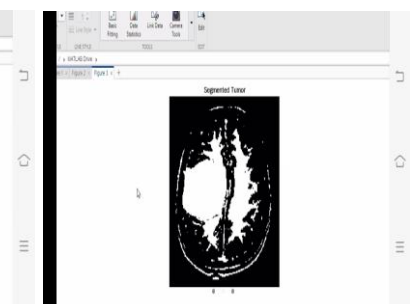


Fig 5.1 Input image 1**Fig 5.2**Threshold image1

Fig 5.3Segmented image1

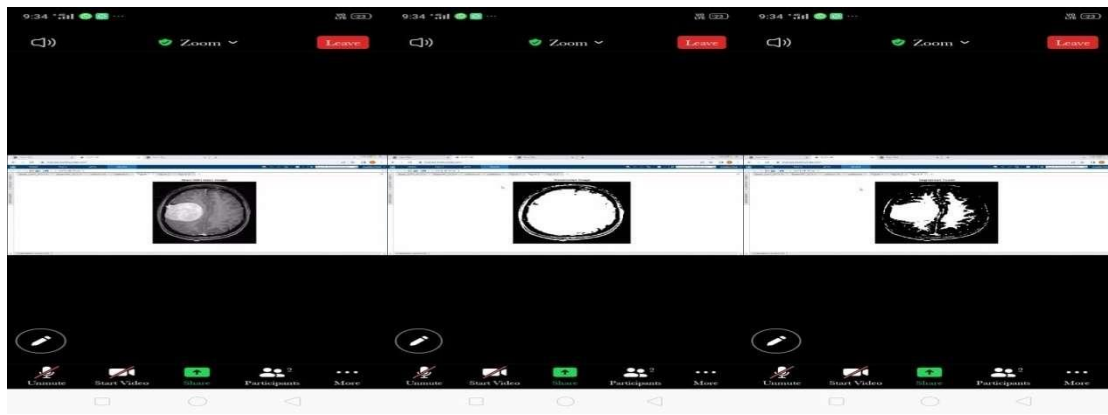


Fig 5.4Input image 2 **Fig 5.5** Threshold image 2 **Fig 5.6** Segmented image 2

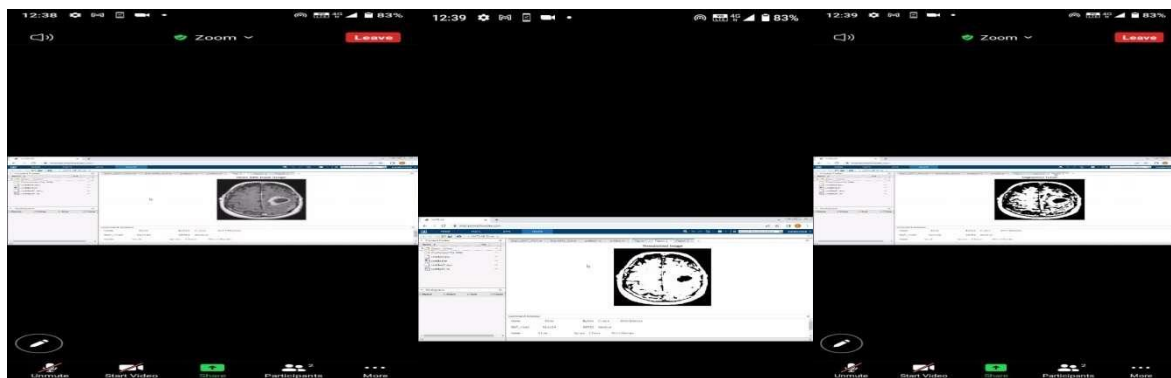


Fig 5.7Input image 3 **Fig 5.8**Threshold image 3 **Fig 5.9**segmented image3

MALIGNANT(✖):

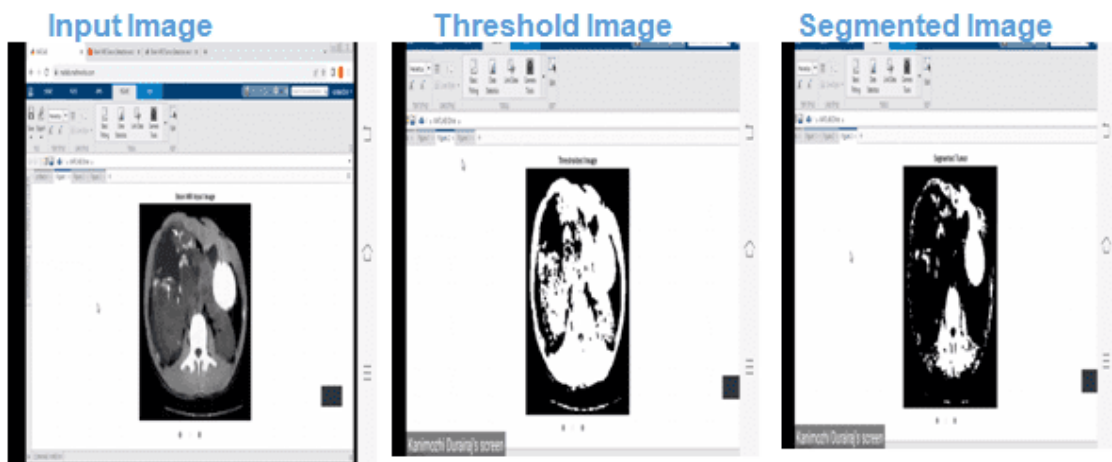


Fig 5.10 Input Image 1 Fig 5.11Threshold Image1 Fig 5.12Segmented Image1

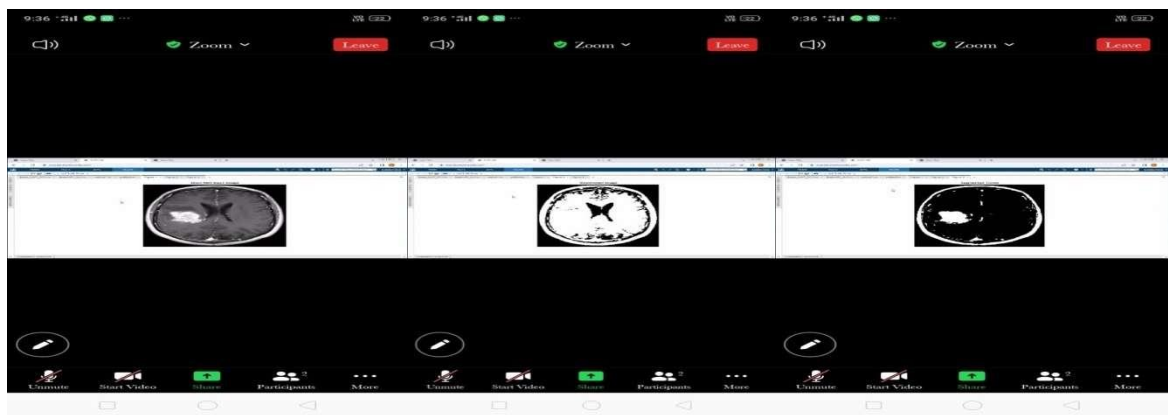


Fig 5.13 Input 2 Fig 5.14 threshold image 2 Fig 5.15 Segmented image 2

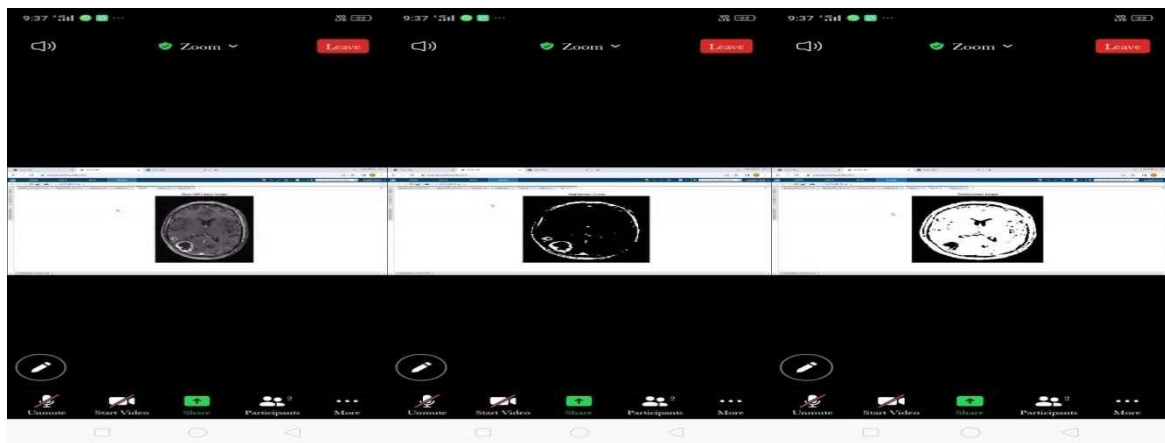


Fig 5.16 Input 3

Fig 5.17 threshold image 3

Fig 5.18 Segmented image 3

ACCURACY

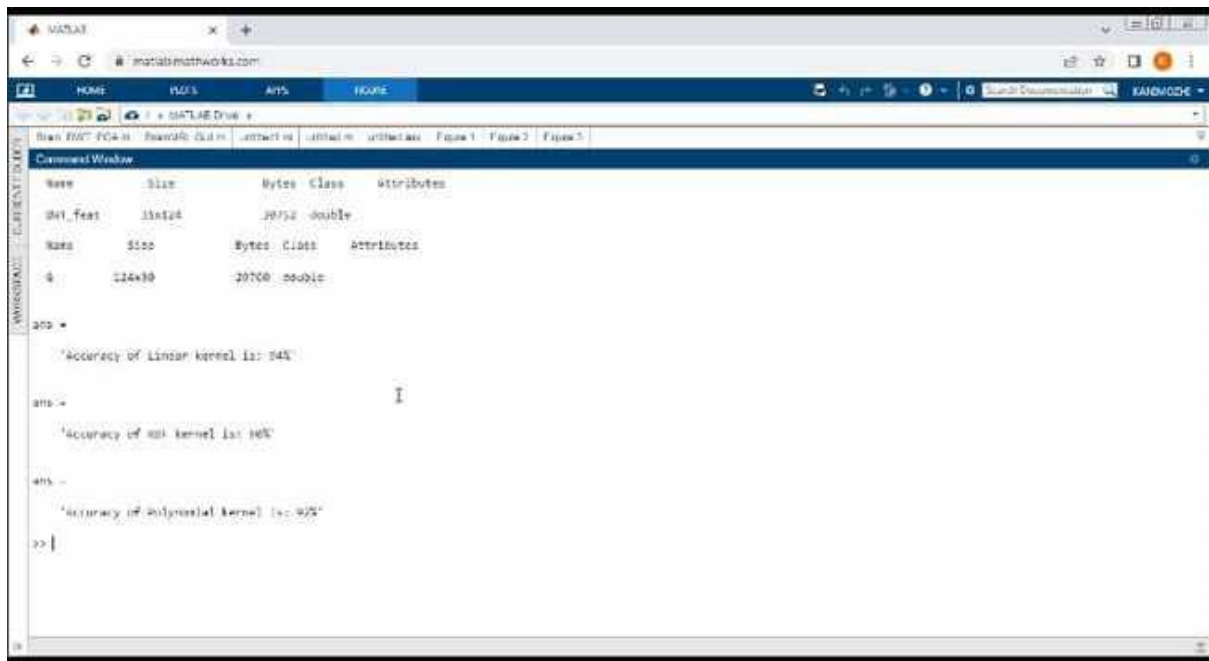


Fig 5.19

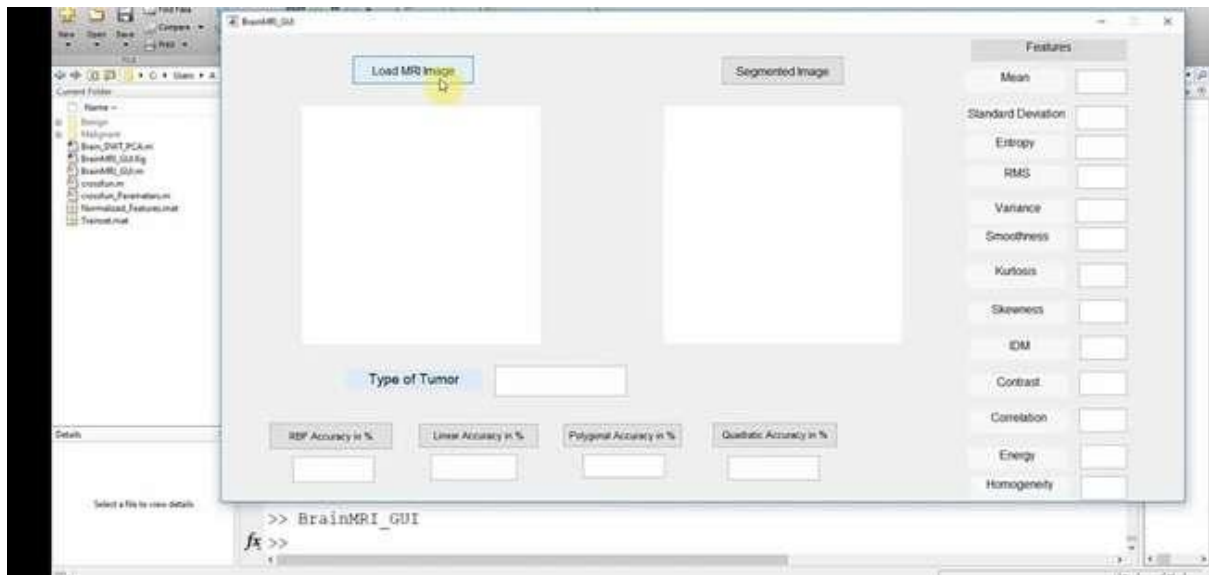


Fig 5.20





Fig 5.22



Fig 5.23



Fig 5.24

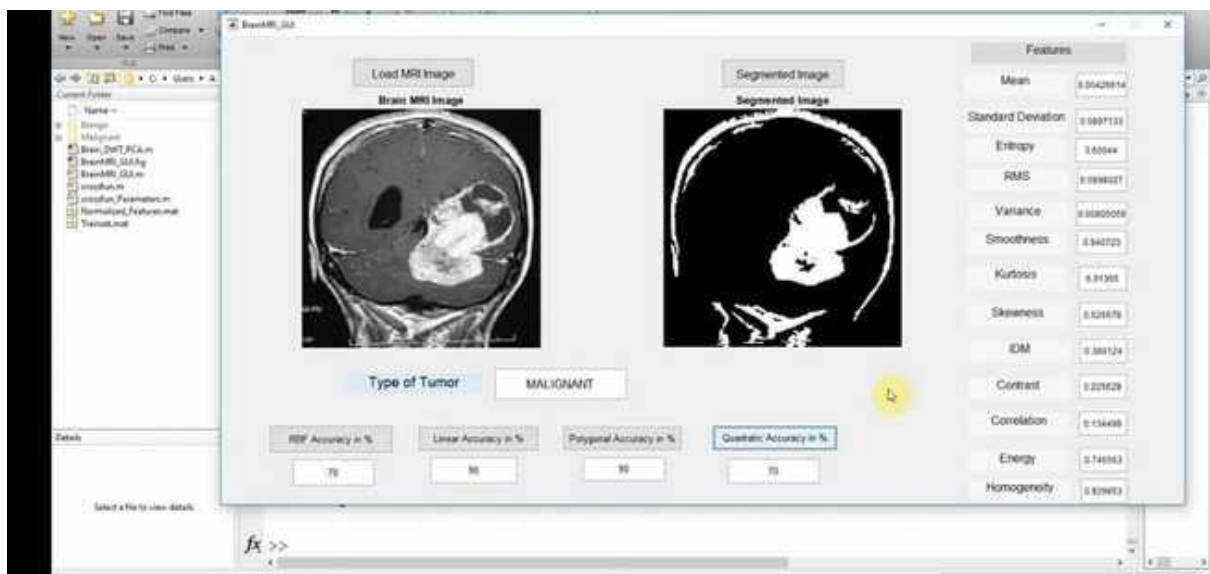


Fig 5.25

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 CONCLUSION

- MRI image segmentation is a very important but inherently difficult problem in medical image processing.
- Here we've proposed an efficient organization supported neural networks to detect the tumor.
- The MATLAB simulation is carried with different brain images and then the tumor will be detected.
- The future work is to enhance the classification accuracy by extracting more features and increasing the training data set. Improve testing accuracy and computation time by using classifier boosting techniques like using more number images with more data augmentation, fine-tuning hyper parameters, training for a extended time i.e. using more epochs and adding more appropriate layers etc.

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