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BRAIN TUMOR DETECTION USING MACHINE LEARNING IN GUI

A Report for the Evaluation 3 of Project 2

Submitted by

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SCHOOL OF COMPUTING AND SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

Certified that this project report **"BRAIN TUMOR DETECTION USING MACHINE LEARNING IN GUI"** is the bonafide work of "**AKSHITA RAWAT (1613101097)"** who carried out the project work under my supervision.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The Medical field of imaging is gaining significant prominence with an expansion of the interest for computerized, definitive, quick and systematic diagnosis and can give knowledge to the image better than the human's eye. In today's world Brain tumor is the main source of cancerous deaths among people. Brain tumors are dangerous, tender and may out-turn in varying ailments, if not restored accurately. Normally cells evolve in a controlled manner as new cells changes old or damaged cells and tumor cells reproduce unmanageably. Recognization plays a vital role in the discovery of malignant and benign tumors. This paper will discuss about such an algorithm that can notify the customer about the tumor information using Image Pre-Processing technique, Segmentation, Localization, Feature Extraction and Classification. Using GUI (Graphical User Interface), a user friendly environment has been developed in MATLAB. In this, we establish a computerized brain tumor detection set up for the MRI scanned images .GUI tool helps the doctors and other specialist to encourage in distinguishing the shape, size and the structural feature extraction of a tumor.

Keywords- Brain , Brain Tumor , Pre-processing , Segmentation , Feature extraction , Classification and GUI.

CHAPTER 1

1 Introduction

1.1 General

The driving force of this project is to create a transparent environment where medical staff and patient can work in complete cooperation to achieve better results. This transparent environment will help the patient to feel secure as they will understand the treatment-process choice, which in turn will help the medical staff to handle the situation in a calm order giving them more time to think and work.

1.2 Motivation

A brain tumor is defined as abnormal growth of cells within the brain or central spinal canal. Some tumors can be cancerous thus they need to be detected and cured in time. The exact cause of brain tumors is not clear and neither is exact set of symptoms defined, thus, people may be suffering from it without realizing the danger. Primary brain tumors can be either malignant (contain cancer cells) or benign (do not contain cancer cells) [1]. Brain tumor occurred when the cells were dividing and growing abnormally. It appears to be a solid mass when it diagnosed with diagnostic medical imaging techniques. There are two types of brain tumor which is primary brain tumor and metastatic brain tumor. Primary brain tumor is the condition when the tumor is formed in the brain and tended to stay there while the metastatic brain tumor is the tumor

that is formed elsewhere in the body and spread through the brain [2].The symptom having of brain tumor depends on the location, size and type of the tumor. It occurs when the tumor compressing the surrounding cells and gives out pressure. Besides, it also occurs when the tumor blocks the fluid that flows throughout the brain. The common symptoms are having headache, nausea and vomiting, and having problem in balancing and walking. Brain tumor can be detected by the diagnostic imaging modalities such as CT scan and MRI. Both of the modalities have advantages in detecting depending on the location type and the purpose of examination needed. Images play an important role in every field that makes the issue more obvious. Image Processing Techniques are broadly used in medical imaging to recognize the affected area through X-rays, CT Scans, MRI Scan. Image Processing is used to discover and distinguish the inner most parts of human body. Magnetic Resonance Imaging is a 3-D non-invasive imaging methodology which is best for detection of a brain tumor because of its high declaration and ability to show clear brain structures, tumors size and location.

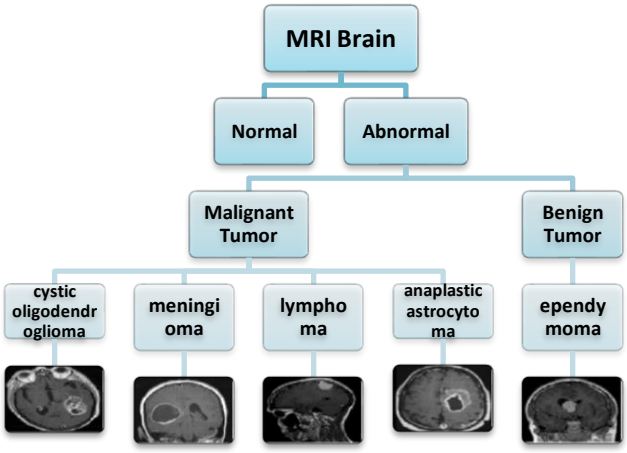


Figure 1.2.1: Five types of MR Images

1.3 Aim & Objective – Problem Description

The aim of the paper is tumor identification in brain MR images. The main reason for detection of brain tumors is to provide aid to clinical diagnosis. The aim is to provide an algorithm that guarantees the presence of a tumor by combining several procedures to provide a fool proof method of tumor detection in MR brain images. The methods centers around the image preprocessing strategy such as Segmentation, extraction and classification. The consequent images will have the alternative to give information like position, dimension and size of the tumor that can demonstrate helpful for different cases, which will help the staff to choose the relieving methodology.

1.4 Related Work

The Brain tumor recognition from MRI is a very complex procedure, hence (AI) Artificial Intelligence plays an important role to detect the exact position of the tumor in

an MRI. Hassan Khotanloua et.al [3] proposed a modern technology to divide brain tumor in a 3-D MR Images. The initial phase in the proposed methodology is the Brain MRI Segmentation using a modern and powerful technique to detect tumor. Then Tumor detection was performed depending upon selecting Asymmetric areas. This methodology considered to be the brain symmetry plane and used fuzzy classification .Its outcome shapes the initialization of a segmentation procedure depending upon a combination of a spatial relation and de-formable model, directing to exact segmentation of the tumor.

Rajeswari S.et al [4] proposed a methodology based upon the quality feature such as GLCM (Grey Level Co-Occurrence Matrix) for MR Images. In this paper "Tumor Detection using Threshold operation in MRI Brain Images" by Natarajan P.et.al [5] states that Primary brain tumors comprise of tumors that begins from the brain. Primary brain tumor can begin from braincells, the meninges,glands or gloves.Tumor can destroy braincells and are very dangerous to human life.A Secondary brain Tumor is cancerous, may be present anywhere in the body and spread to the brain.

But our strategy mutually tackles the issue of detecting Brain tumor detection using MRI with the help of Machine Learning using proposed methods like Image Pre-processing, segmentation ,feature extraction and classification.

1.5 System Requirements

Table 1.5.1 System requirements

Operating System	Processors	Disk Space	RAM
Windows XP Service Pack 3 Windows Server 2003 R2 with Service Pack 2 Windows Vista Service Pack 1 or 2 Windows Server 2008 Service Pack 2 or R2 Windows 7,10	Any Intel or AMD x86 processor supporting SSE2 instruction se	1 GB for MATLAB only, 3–4 GB for a typical installation	1024MB (At least 2048 MB recommended)
Mac OS X 10.5.5 (Leopard) and above Mac OS X 10.6.x (Snow Leopard)	All Intel-based Macs	1 GB for MATLAB only, 3–4 GB for a typical installation	1024MB (At least 2048 MB recommended)
Ubuntu 8.04, 8.10, 9.04, and 9.10 Red Hat Enterprise Linux 5.x SUSE Linux Enterprise Desktop 11.x Debian 5.x	Any Intel or AMD x86 processor supporting SSE2 instruction set	1 GB for MATLAB only, 3–4 GB for a typical installation	1024MB (At least 2048 MB recommended)

CHAPTER 2

2 Overview of the Proposed System

2.1 Proposed solution

The algorithm is a set of image processing fundamental procedures. A set of noise-removal functions accompanied with morphological operations that result in clear image of tumor after passing through high pass filter is the basic idea behind the proposed algorithm. The set of morphological operations used will decide the clarity and quality of the tumor image. A GUI is created in the MATLAB offering the proposed application of extracting the tumor from selected brain image and its visualization using contour plot. Without having to deal with the code, medical staff can select the images and study the extracted tumor.

3 Analysis and Design

3.1 Requirement Analysis

System requirements set out what the system should do without specifying how it should be done. The requirement set out in this document is complete and consistent. There are 2 types of user of this software-

1. Patient

2. Doctor

1. Patient can use the software to see the size of the tumor. It's easy for the laymen to understand the size and position of the tumor.

2. Doctor are using for extracting of tumor from MRI scan images of brain and visualization of tumor.

3.1.1 Functional Requirements

- Selecting the MRI scan images of brain.
- Extracting only tumor region from the scan images.
- Finding the boundary of the tumor.
- Creating a GUI for easy access of the program.

3.1.2 Non Functional Requirements

- Availability- The software for Extraction of brain tumor from MRI scan images can be available in all the systems who have MATLAB installed.

- Reliability- This software attempts to insure appropriate content but assume no responsibility for external manipulations.
- Performance- CPU time of the proposed software varies from 4seconds to 6seconds and PSNR value from 25dB to 26dB.

3.2 Design of the proposed system

3.2.1 System Architectural Design

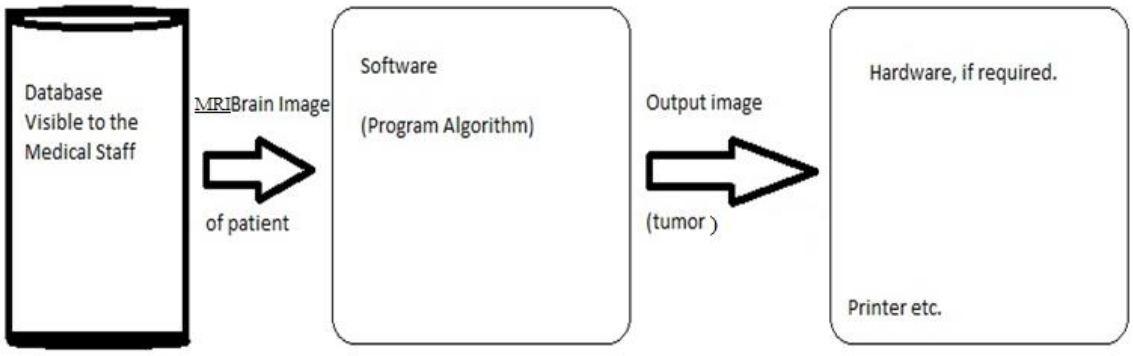


Fig 3.2.1.1.System Architectural Description

3.2.2 Considered Design Constraints

3.2.2.1 User Interface Constraints

Using this system is fairly simple and intuitive. A user familiar with basic computer operability skills should be able to understand all functionality provided by the system.

3.2.2.2 Hardware Constraints

The system should work on most home desktop and laptop computers and can be extended to mobile phone apps.

3.2.2.3 Software Constraints

The system is designed to run on MATLAB having GUIDE.

3.2.2.4 Communications Constraints

System must have access to the images of CT scan for brain tumour.

3.2.2.5 Data Management Constraints

System shall be able to interface with other components according to their specifications.

3.2.2.6 Operational Constraints

The system is not limited to any Operating System. It works in equally good in Windows ,Mac and LINUX.

4 Implementation

4.1 Methodology

The proposed approach centers around the image pre-processing strategy such as Segmentation, extraction and classification. The Segmentation is used to segment and group the region. The extraction is used to extract the data from the segmented image. Classification is used to compare the extracted data with the data set. This algorithm depends upon brain images filtering which is used to remove noise from an image, segmentation of filtering image, extract the data from segmented image and compare the information with data sets. The feature which was extracted from the image are deposited in the knowledge base. A suitable classifier designed to identify the brain tumor by choosing different feature. MATLAB GUI tool should be used to design a user-friendly environment.

Figure 4.1: Block Diagram for proposed methodology

4.1.1 Image Acquisition

Image acquisition is the first step in the form of RGB image. The original MRI brain image has properties 256*256*3 and conversion to gray scale image makes the properties 256*256. Various steps are formulated in the figure, after acquisition of image convert to gray scale and the contrast is increased up to a certain level. Contrast image is partitioned into left and right hemisphere [6]. Threshold / Binarization convert the image up to 256 gray levels into black and white image as shown in below figure:

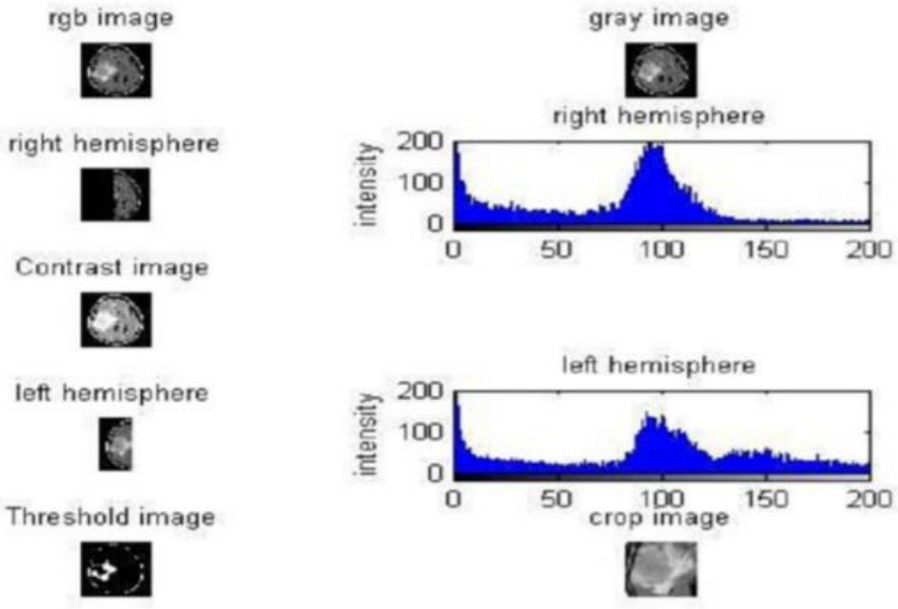


Figure 4.1.1.1: Morphological Operations

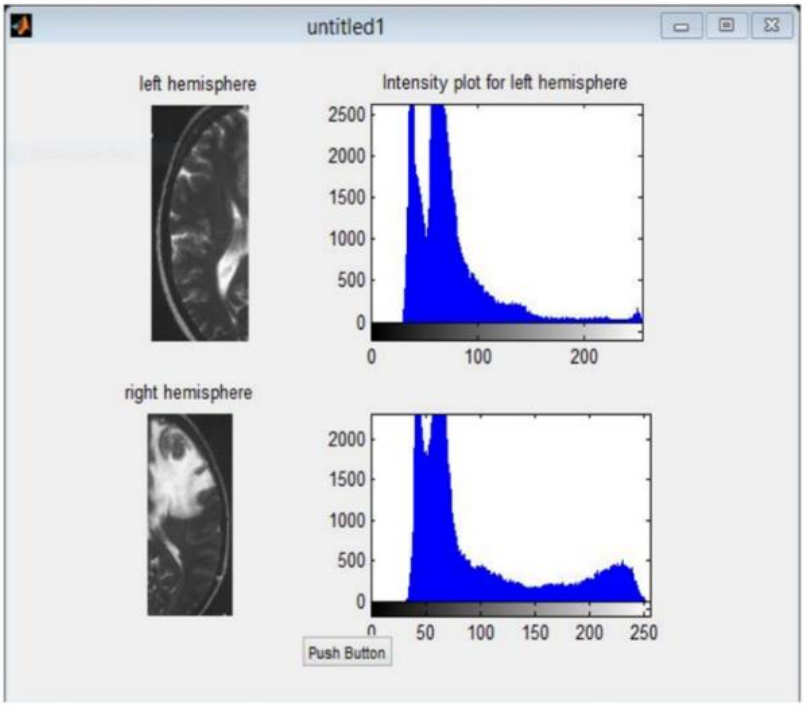


Figure 4.1.1.2: Intensity plot between left & right hemisphere

From the above figure, it is proven that the histogram arranged for right and left hemisphere are not aligned. Right hemisphere has more divergence in the intensity. So there might be an opportunity of tumor on right side of the brain due to the no. of white pixels is extra in the right hemisphere of the brain. By executing various morphological operations, we can identify the tumor on either sides of hemisphere, but we cannot extract or remove the noise correlated to the edge [7]. So we have to remove noise by pre-processing.

4.1.2 Pre-processing

Dismissal of unfortunate noise and image amplification are the two main aims of this step. The image properties can be strengthened by using image pre-processing technique. After enhancement of image, we have to extricate the edges. Our interest is to eliminate

the tumor from its background.

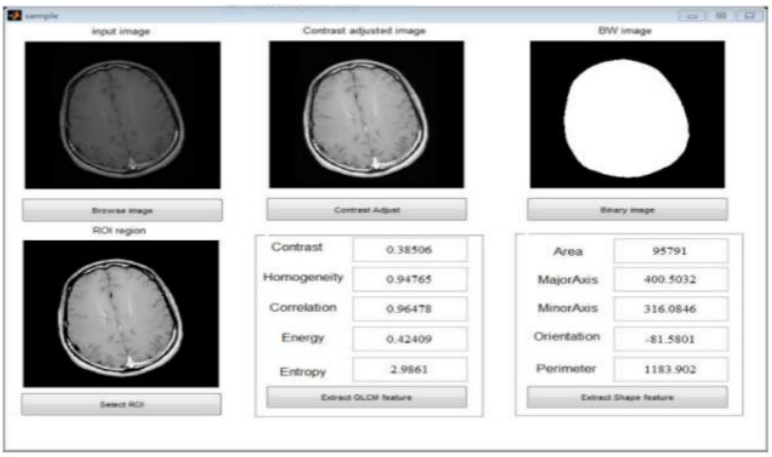


Figure 4.1.2.1: GUI for Pre-processing

4.1.3 Segmentation

Segmentation in medical imaging is a demanding and complicating procedure for the exact recognition of the brain tumor. A no. of clinical trials are executed for identification of pattern of brain tumor. The main motive of segmentation is to divide the images into multiple segments which is more important and easy analyze.

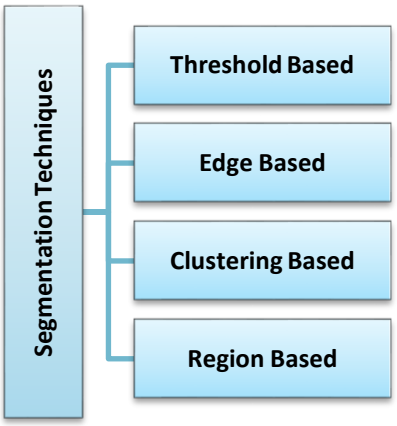


Figure 4.1.3.1: Segmentation techniques

4.1.4 Feature Extraction

In feature extraction we use GLCM method. A (GLCM) Grey-level co-occurrence matrix contains data about the location of pixels having similar grey level values [8]. In Feature extraction, suitable data is extricated from the input data. After the feature extraction, a common method of selection is SFS in which (statistical function) is used. By applying GLCM calculation 10 invariant features:

a. Dissimilarity

b. Homogeneity

c. Autocorrelation

d. Entropy

e. Correlation

f. Cluster shade

g. Contrast

h. Maximum Probability

i. Energy

j. Cluster Prominence

4.1.5 Classification

Support vector machines are supervised learning models with related learning algorithms that study data and recognize patterns used for classification and regression analysis and gives computers an ability to learn without executing programming.

Classifier is used to decide whether it's normal or abnormal. SVM is a binary classification method in which two classes is taken as an input data. For example, we take '0'for normal whereas we take '1'for abnormal. We use the parameters from feature extraction. [9]

SVMStruct = svmtrain(Training, Group)

SVMStruct: It contains data about the trained SVM classifier.

There are two inputs:

1. The first is about matrix of training data, where row represents no. of observations, and column represents various features.
2. The second is about the group, same no. of elements as there are number of rows for training.

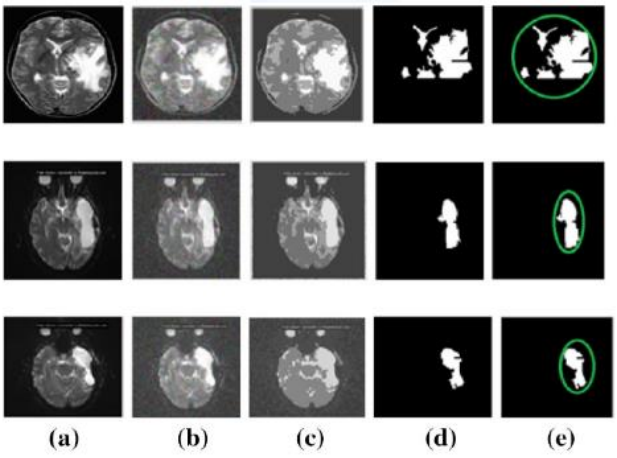


Figure 4.1.5.1: Detection of Tumor

4.2 Execution

4.2.1. User Interface Design

The prototyping of the GUI is done by MATLAB.

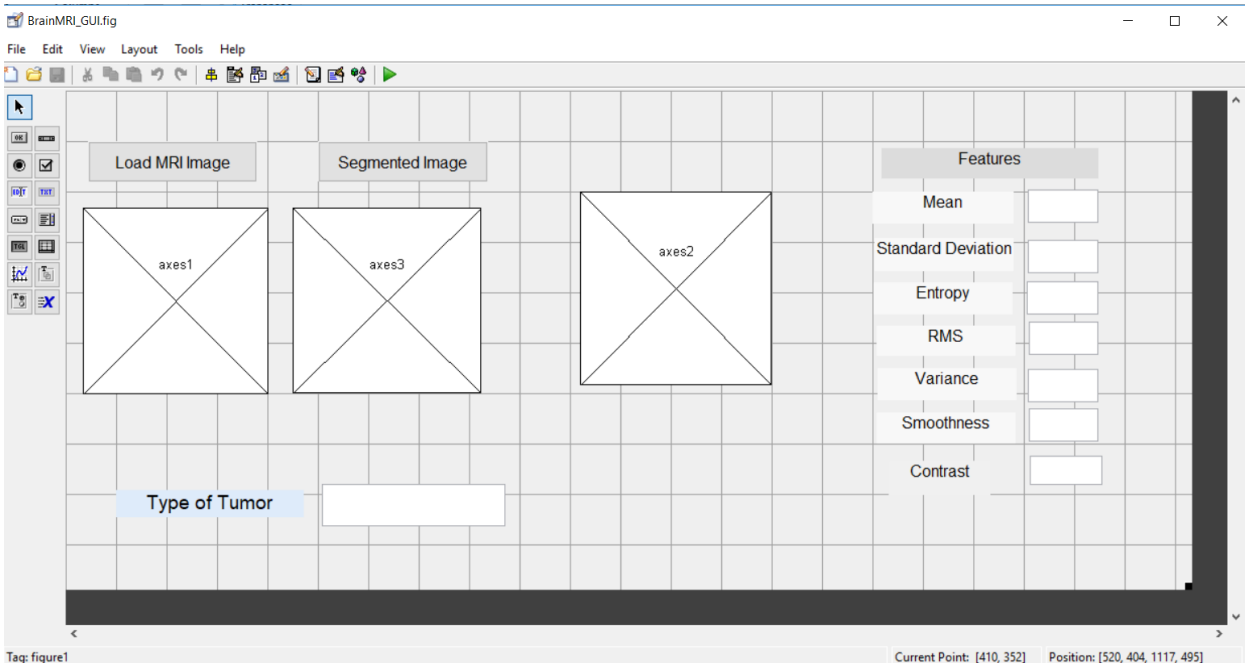


Fig.4.2.1.1 Prototype GUI

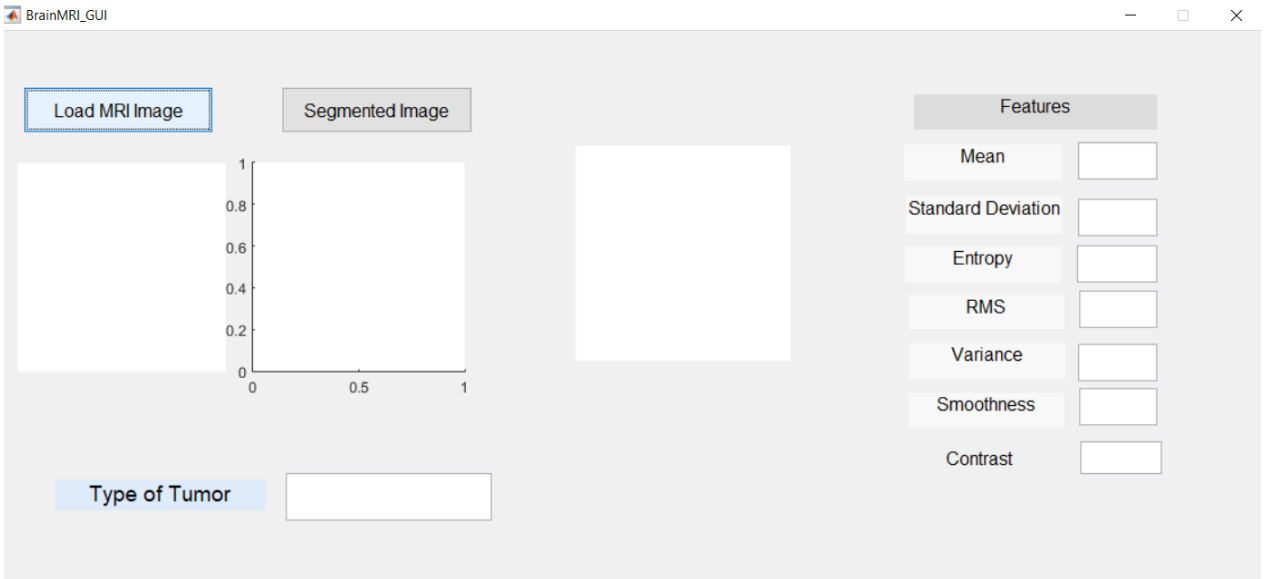


Fig.4.2.1.2.Original GUI

4.2.2 Test Cases

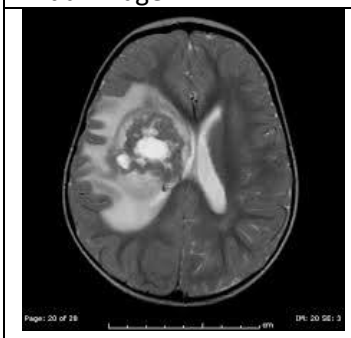
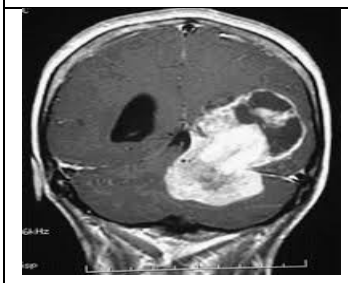
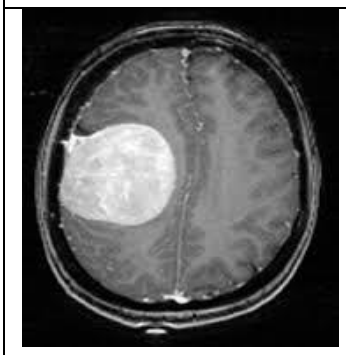
Initial image	Expected Output	Obtained Output
		
		
		
		

Table.4.2.2.1 Test Cases

5 Results and Discussion

5.1 Result

The proposed system is implemented using a MATLAB R2017a. This paper focuses upon the detection and visualization of a tumor in the brain from MR images. By developing the proposed architecture, the demarcation of the tumor in the MR image is obtained. The following results showcase the outputs received after each step in the algorithm. After the original image undergoes pre-processing transformations, we get figure 8 from figure 7. These basic pre-processing transformations include:

1. Changing the image to greyscale, as we need to find contour of the final image which works on greyscale images.

2. Applying low pass filter, to remove any noise, if present, in the image.

3. Applying high pass filter, to obtain sharpened image with clear-defined boundaries.

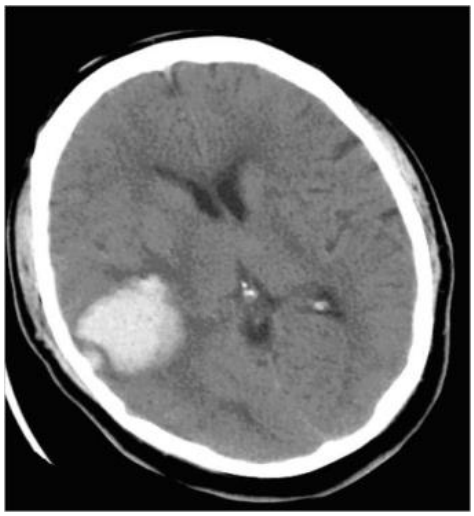


Fig. 5.1.1. Original image

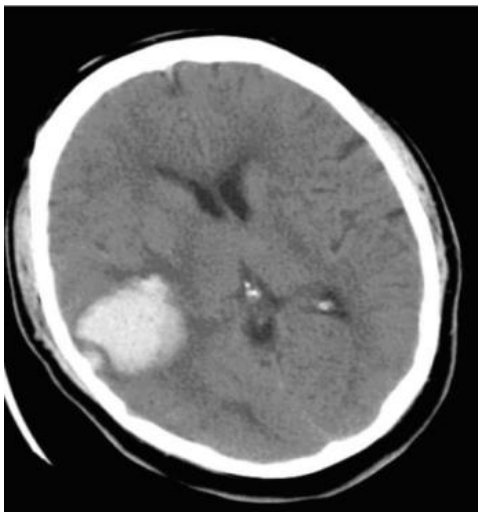


Fig. 5.1.2. Pre-processed image

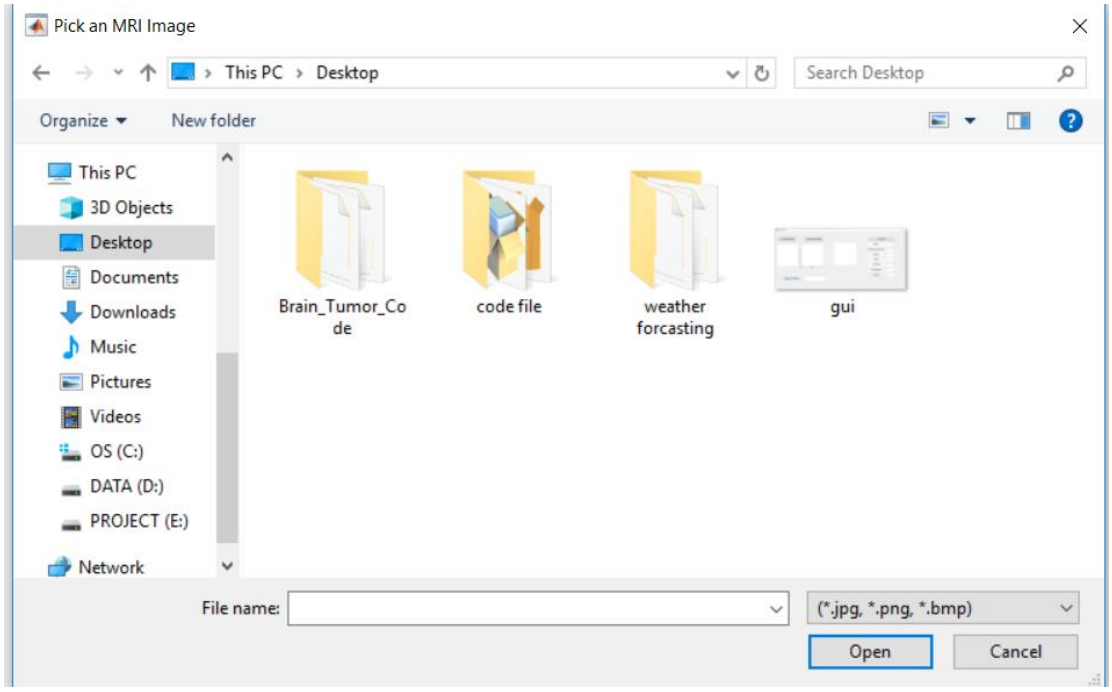


Fig.5.1.3 Interface to select an image.

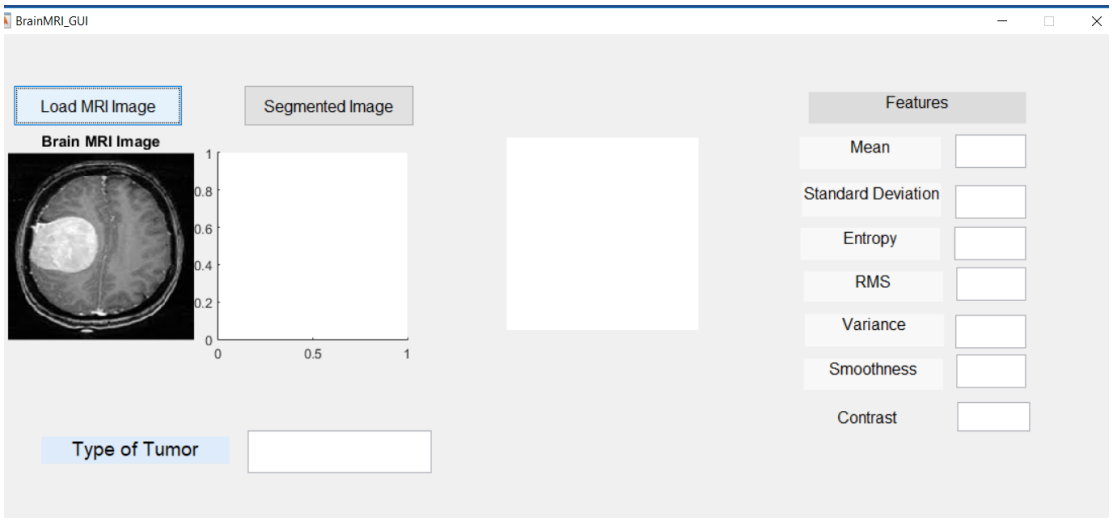


Fig 5.1.4 Start screen of GUI

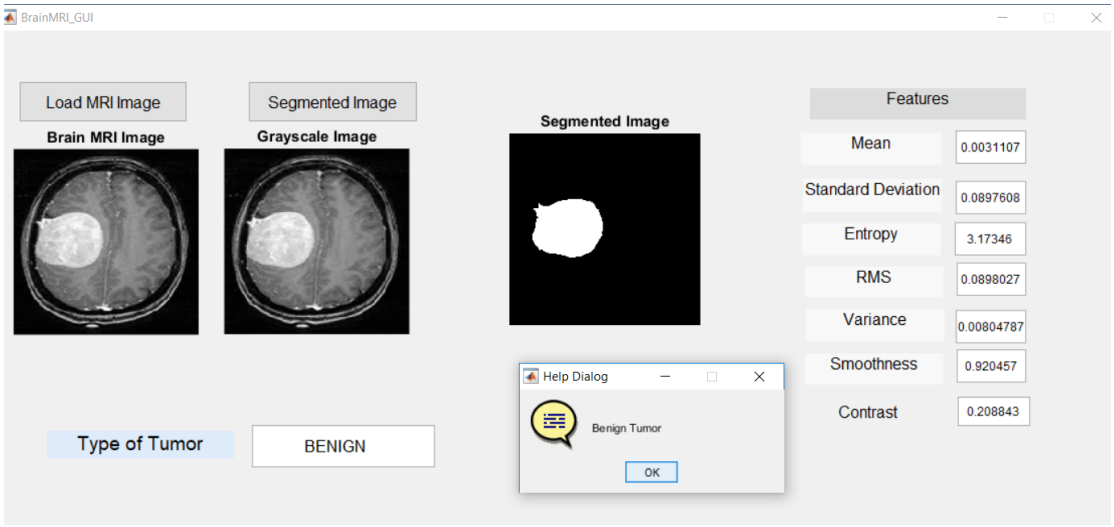


Fig. 5.1.5. Final Result

5.2 Experimental Results

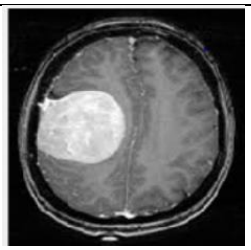
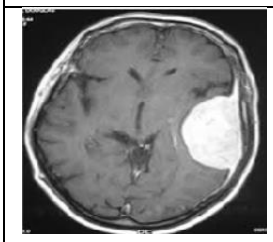
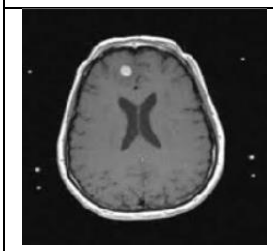
The experiment was carried out on 212 brain MR images. From each image, the texture based features are extracted and weka tool is used for classification. The texture based features such as energy, contrast, correlation, homogeneity are extracted using GLCM. The Multi-Layer Perceptron (MLP) and Naïve bayes with 66% percentage split is used for classification. In 66% percentage split, 66% of the instances are used for training and remaining instances are used for testing.

CHAPTER 3

6 Conclusion and Future Enhancements

The proposed algorithm is inputted with gray scale images of brain that contain tumor's. The image is processed through various stages of morphological operations through MATLAB programming. Hence, the tumor is outlined in the original image and clearly demarcated. A GUI is also developed which enables the above application with a user-friendly interface.

Table 6.1. Table to show accuracy of algorithm

Image	CPU time	Mean	Standard Deviation
	**2.2656**	**0.0031107**	**0.0897608**
	**3.0156**	**0.00282896**	**0.0897701**
	**4.7344**	**0.0043601**	**0.0897088**

	**4.7188**	**0.00365066**	**0.0897405**

Possible extension of the presented work could use more features. It would be beneficial to connect the system to cloud storage of patient's information in hospital. The application can be extended to accessibility and usability through mobile phones.

7 References

[1] Mustaqeem, Anam, Ali Javed, and Tehseen Fatima, "An efficient brain tumor detection algorithm using watershed and thresholding based segmentation", International Journal 4, 2012

[2] Nidhi, P. Kumari, "Brain Tumor and Edema Detection Using Matlab",International Journal of Computer Engineering and Technology (IJCET), ISSN 0976 - 6375(Online), Volume 5, Issue 3, March (2014), pp. 122-131.

[3] Hassan Khotanloua, Oliviercolliotb, Jamalatifc and Isabellebloch "3D Brain Tumor Segmentation In MRI Using Fuzzy Classification, Symmetry Analysis and Spatially Constrained Deformable Models", Available Online At Www.Sciencedirect.Com, Fuzzy Sets And Systems 160 ,1457–1473,2009.

[4] Rajeswari S and Theiva Jeyaselvi K,"Support Vector Machine Classification For

MRI Images", International Journal of Electronics and Computer Science Engineering, V1N3-1534-1539,2013.

[5] Natrajan P. , Krishnan N. , Natasha Sandeep kenkre and et.al ,"Tumor Detection using Threshold operation in MRI Brain Images," IEEE International Conference on Computational Intelligence and Computing Research, 2012.

[6] Sonu Suhag and L. M. Saini," Automatic Detection of Brain Tumor by Image Processing in MATLAB" International Journal of Advances in Science Engineering and Technology, ISSN: 2321-9009 Volume- 3, Issue-3, July-2015

[7] Manoj K Kowar and SourabhYadav, "Brain Tumor Detction and Segmentation Histogram Thresholding". International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-1, Issue-4, April 2012

[8] M.Karuna, A. Joshi, "Automatic detection and severity analysis of brain tumors using GUI in MATLAB" IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163, pISSN: 2321-7308.

[9] S. Chaplot, L.M. Patnaik, N.R. Jaganathan, "Classification of magnetic resonance brain images using wavelet as input to support vector machine and neural network", Biomed. Signal Process. Control (2006) 86-92.