SPECIAL PROJECT

Final

PROJECT REPORT

ON

Brain Tumor Detection From MRI Using Machine Learning Algorithm

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REPORT

ON

Brain Tumor Detection Using MRI Image Processing

BY

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DECLARATION

I declare that the work contained in the Project Report is original and it has been done by me under the supervision of **Dr. Movva Pavani**. The work has not been submitted to any other University for the award of any degree or diploma.

Signature of the student

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ABSTRACT

Title: *Brain Tumor Detection Using MRI Image Processing in **MATLAB** Programming.*

The Project is based on Brain Tumor Detection using Image Processing using MATLAB Programming Language. MRI images are more susceptible to noise and other environmental disturbances. At present, it's also difficult for doctors to detect brain tumors using machines at this stage. Early imaging techniques such as pneumoencephalography and cerebral angiography had the drawback of being invasive and hence the CT and MRI techniques helped doctors in providing better vision. So, in this abstract, we detect brain tumors from images. Here we convert an image to a grayscale image. We apply filters to the image to remove noise and other environmental disturbances from the image. The system will process the selected image using pre-processing steps. Different algorithms are used to detect the tumor from an image to detect the edges of an image we use segmentation. Because in the early stages of a brain tumor the edges will not be sharp of the image. Therefore, the accuracy can be improved throughout the process.

Keywords: A brain tumor, CT, MRI, Segmentation, MATLAB.

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Chapter I: INTRODUCTION

1.1 Introduction

A brain tumor is the most commonly occurring malignancy among human beings, so the study of brain tumors is important. It is a major cause of the increase in mortality among children and adults. A tumor is defined as the abnormal growth of the tissues. Brain tumors are generally classified into two types benign and malignant tumors. MRI imaging plays an important role in the brain tumor analysis, diagnosis, and treatment planning period. It is helpful to doctors to determine the previous steps of brain tumors. The detection of brain tumors using MRI images is a challenging task because of the complex structure of the brain. MRI images provide better results than CT scans, ultrasound, and X-rays because it is an advanced medical imaging technique and it used powerful magnets to provide high resonance images of all parts of the body. These MRI images can be processed on one can detect the brain tumor using image processing techniques by formatting and automatic detection process using various algorithms because the manual detection of tumors from MRI images may give a human error. The symptoms of a brain tumor depend on the tumor as type and location. Some common symptoms of brain tumors are headaches and nausea, vomiting.

1.2 Literature Survey

Pradeep Singh Yadav 2017 [1]: This paper provided that in the MRI report cancer affected area is of high-intensity pixels and normal tissue is of low-intensity pixels. Segmentation using only intensity as a parameter is called thresholding. This is a basic type of segmentation that classifies the tumor based on the gray level. Basic morphological commands such as erode and dilate are used to extract the tumor but in our proposed method along with these commands, the region of interest is detected in some of the features of the tumor extracted.

Swapnil R. Telrandhe 2018 [2]: This paper proposed that tumor detection inside which segmentation separates an image into parts of regions or objects. In this, it has to segment the item from the background to browse the image properly and classify the content of the image strictly. SVM classification and tumor stage classification are the key image processing techniques for the brain and MRI image segmentation is classified as SVM.

Luxi Kapoor 2017 [3]: In this paper, he suggested the numerous steps that are indulged in the detection of tumors, and prove that Segmentation is the most significant and propitious.

Nilesh Bhaskarrao Bahadure 2017 [4]: In this paper new approach has been proposed that can provide help in the quick, accurate, and timesaving detection of tumors in the brain and also provide the exact location where the tumor originated with good accuracy.

Clatz (2015) [5]: MRI is one of the good imaging techniques to provide tissue characteristics. The brain is an important organ of our human body, Because of its complex structure, the anatomy of the brain is scanned by MRI or CT, but the MRI is a more suitable technique than the CT for diagnosis. Because it does not use harmful radiation.

1.3 Problem Statement

A Brain tumor is an abnormal growth of tissues that develop uncontrollably and unchecked by the checkpoints that help regulate cell growth.

How a Brain tumor is diagnosed?

Imaging tests can help doctors find out if the tumor is a primary brain tumor or if it is cancer that has spread to the brain from elsewhere in the body. Imaging tests show pictures of the inside of the body. Most brain tumors are diagnosed after symptoms appear.

Often a brain tumor is first diagnosed by an internist or a neurologist. An internist is a doctor who specializes in treating adults. A neurologist is a doctor who specializes in problems with the brain and central nervous system.

In general, diagnosing a brain tumor usually begins with magnetic resonance imaging (MRI). Once MRI shows that there is a tumor in the brain, the most common way to determine the type of brain tumor is to look at the results from a sample of tissue after a biopsy or surgery.

How would I know if I have a tumor in my head?

Difficulty swallowing, facial weakness or numbness, or double vision is a symptom of a tumor in the brain stem. Vision changes, including loss of part of the vision or double vision, can be from a tumor in the brain stem.

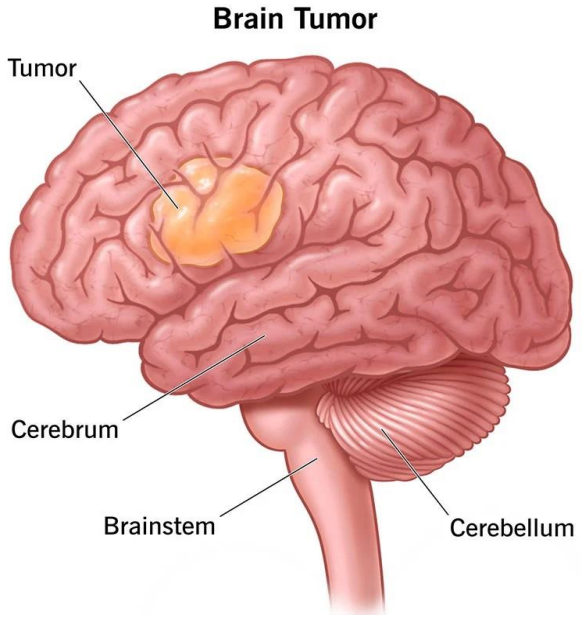

Fig1. Image of a Brain Tumor

1.4 Objective

As medical practitioner pathologist faces various types of problems in detecting tumors manually from the MRI image, there is a need for an automatic detection process. Thus the main aim of the project is to design a framework for the automatic detection of the tumor to obtain more accuracy from the image in the dataset which plays a vital role in the diagnosis of tumors by using various image processing algorithms in MATLAB. This framework will hopefully help the pathologist to reduce the workload and minimize human error while maintaining and improving the accuracy to detect the tumor.

System Requirements:

- **Operating System:** Windows 11
- **Coding Language:** MATLAB Programming
- **Version:** MATLAB R2021a
- **Processor:** Intel i5
- **RAM:** 8GB
- **Hardisk:** 915GB

Chapter II: Principles Applied For Detection of Brain Tumor

2.1 Methodology Used:

The detection and classification of tumors from MRI images is a challenging task because of the complex structure of the brain. The various stages include preprocessing of MRI images segmentation of images feature extraction finally classification.

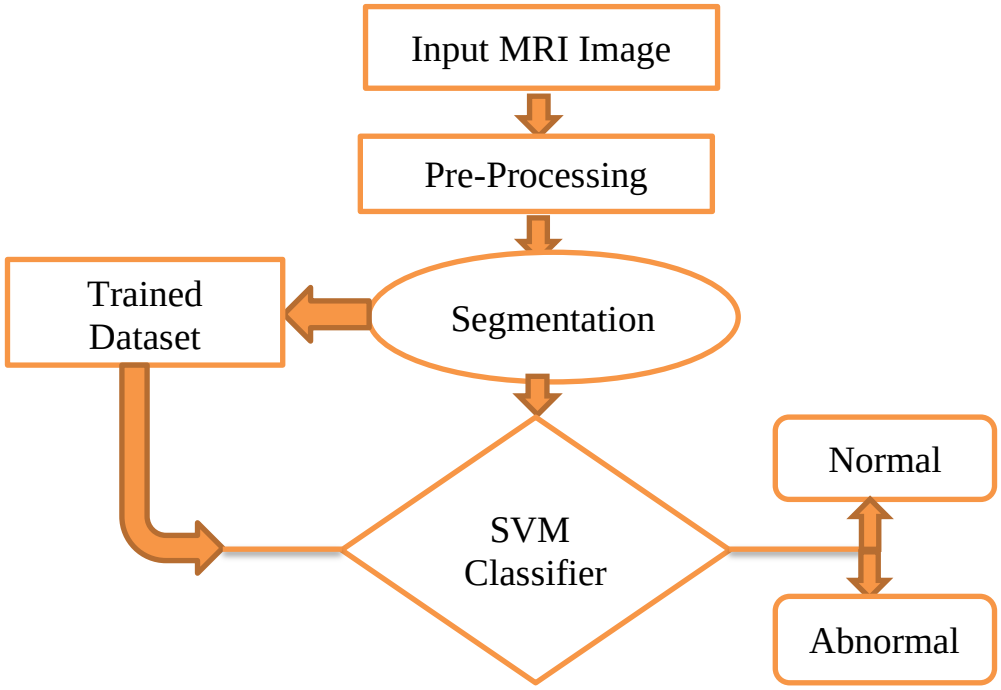

Fig2. Steps for Brain Tumor Detection

- **Input MRI Image:** The first stage is the image acquisition stage which starts with taking a collection of images from the database. Images stored in MATLAB will be displayed as grayscale images.

  The MRI images dataset was collected from the kaggle software, the brain MRI data set consists of 200 images of different resolutions there are 100 known Brain tumors and 100 unknown Brain tumor images.

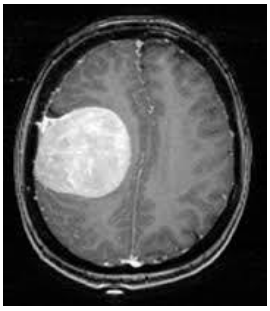

Fig3. Tumor Image

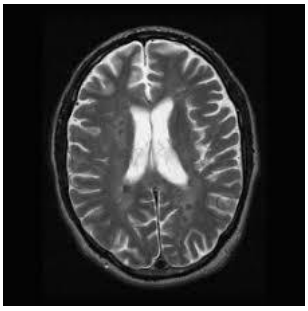

Fig4. No Tumor Image

- **Pre-Processing:** In this process of the second step the images are used to enhance the chances of detecting the suspicious region. Clinical MRI when corrupted by noises reduces the accuracy of the images. So various filters are used to remove these noises. The goal of pre-processing is to remove the noise and to provide contrast enhancement to improve image quality.
  - The functions performed by the preprocessing process are:
    1. Grayscale conversion
    2. Noise removal
    3. Contrast enhancement

- **Segmentation:** This stage is called image segmentation. It is the process of partitioning a digital image into multiple segments. Image segmentation will be typically used to locate objects and boundaries in images and it helps to make the analysis easier. It is the process of assigning a label to every pixel in an image. There are several algorithms for segmentation. The goal of segmentation is to simplify and change the representation of an image into something more meaningful and easier to analyze. Here we have used a machine learning algorithm called Support vector machine (SVM) it is an approach that is considered a good candidate because of its high generalization performance, especially when the size of the function space is very large.

2.2 SVM Algorithm:

SVM stands for support vector machine. SVM is a supervised machine learning algorithm that is commonly used for classification and regression challenges. Common applications for SVM algorithms are intrusion detection systems, handwriting recognition, and brain tumor detection. The SVM approach is considered a good candidate due to its high generalization performance, especially when the dimension of the feature space is very high.

The SVM uses the subsequent idea. It maps the input vector x into a high-dimensional feature house z through some nonlinear mapping. The SVM takes operational images as input and gives the accuracy of a neural network with manual options in a purely handwriting recognition task. An SVM classification is used to classify the brain into neoplasm and non-tumor categories.

The SVM methodology has the advantage of generalization and dealing in high dimensional feature areas, it assumes that knowledge is independently and identically distributed which isn't acceptable for tasks like segmenting medical images with irregularity and noise.

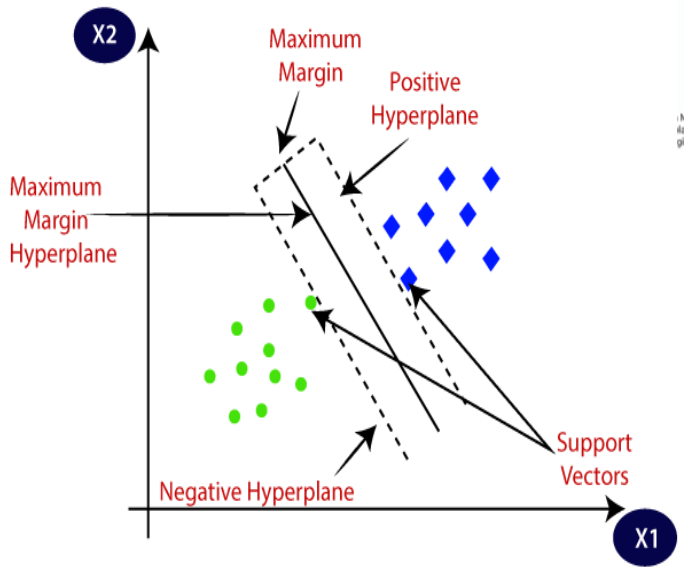

Fig5. Image of an SVM

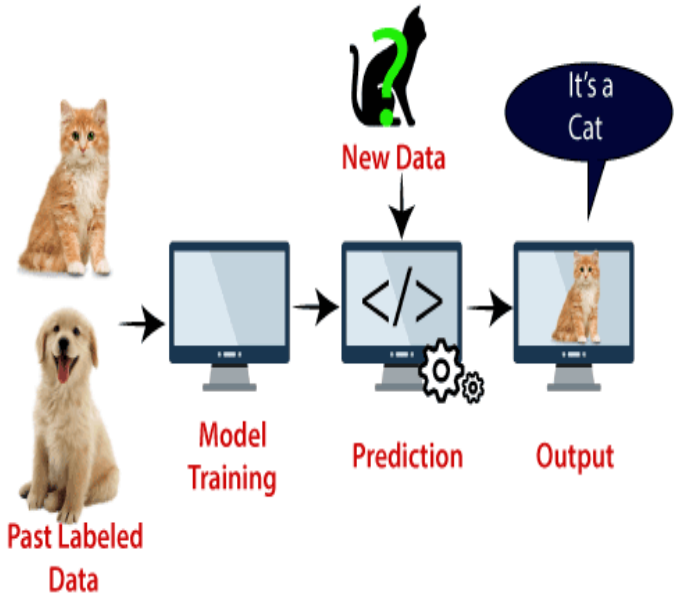

Fig6. Example of SVM

2.3 Magnetic Resonance Imaging (MRI):

Fig7. MRI Scan

Magnetic resonance imaging (MRI), and nuclear magnetic resonance imaging (NMRI) is a medical imaging techniques used in radiology to visualize the internal structures of the body in detail. MRI makes use of the property of nuclear magnetic resonance (NMR) two image nuclei of atoms inside the body.

An MRI scanner is a device in which the patient lies within a large, powerful magnet where the magnetic field is used to align the magnetization of some atomic nuclei in the body, and radio frequency magnetic fields are applied to systematically alter the alignment of this magnetization. This causes the nuclear to produce a rotating magnetic field detectable by the scanner and this information is recorded to construct an image of the scanned area of the body. Magnetic field gradients cause nuclear different locations to process at different speeds, which allows spatial information to be recovered using Fourier analysis of the measured signal. By using gradients in different directions, 2D images or 3D volumes can be obtained in any arbitrary orientation.

From the MRI images, information about abnormal tissue growth in the brain is identified. The MRI also helps in telling the difference between any dead tissue caused by previous radiation treatments and new tumor cells in the brain.

Chapter III: Experimental Results

3.1 MRI Images of the Brain

This is the first step in the code work as we take the input of MRI images of our dataset provided. The resulting MRI images may not have good quality for analysis. Here the MRI images are grayscale images that are taken as input.

Dataset Link:

1. https://www.kaggle.com/datasets/navoneel/brain-mri-images-for-brain-tumor-detection

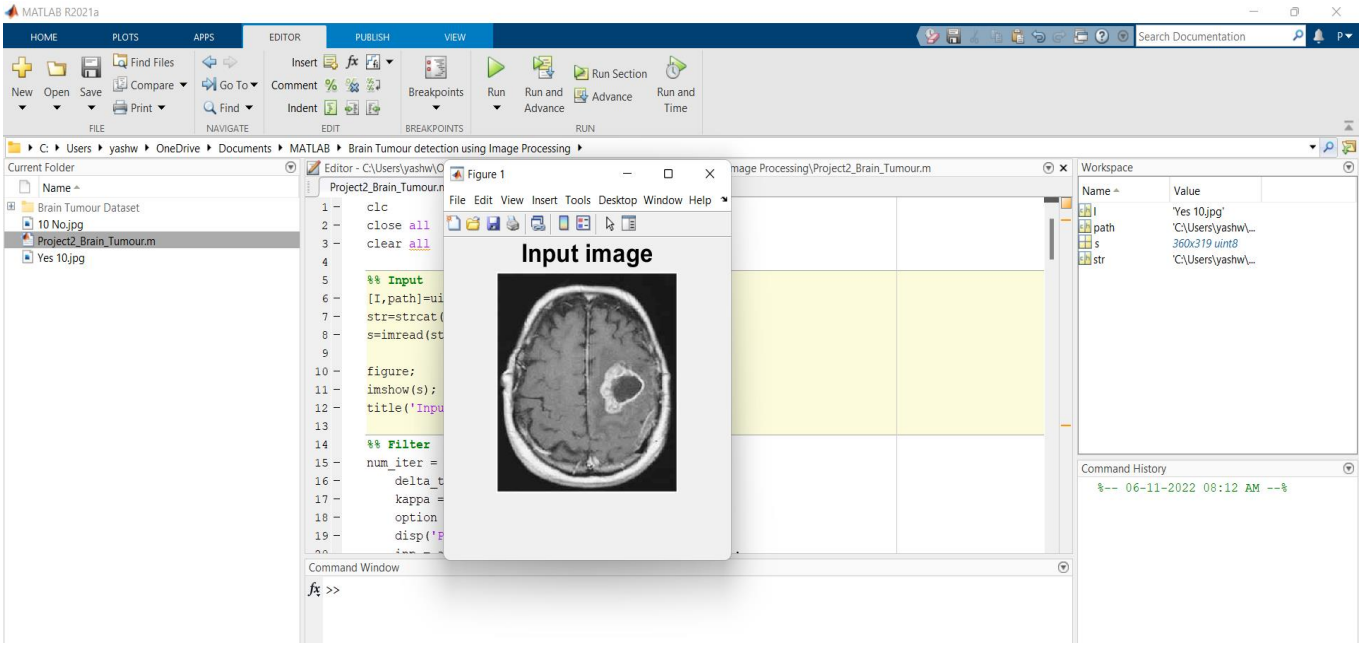

Fig8. Input MRI Image

3.2 A. Bounding Box

The Bounding box is an imaginary rectangular box that contains an object or a set of points. When used in digital image processing, the bounding box refers to the border coordinates that enclose an image. They are often used to blind or identify a target and serve as a reference point for object detection and create a collision box for that object.

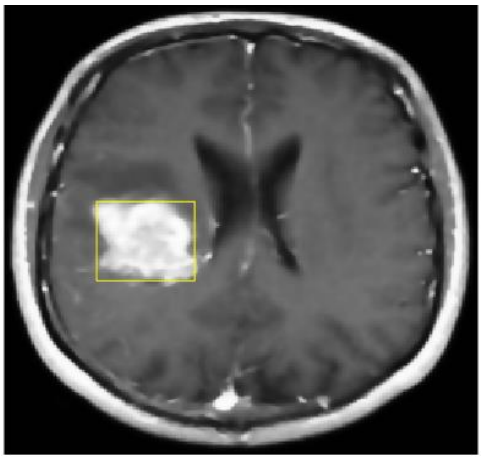

Fig9. Bounding Box

B. Morphological Operation

Morphological Operation is a broad set of image processing operations that extract image components useful in representing region shape, and boundaries. One of the Morphological operations which we used is Erosion. **Erosion** means which removes pixels on object boundaries.

In a morphological operation, each image pixel is corresponding to the value of another pixel in its neighborhood. Morphological operations apply a structuring element called strel in Matlab, to an input image, creating an output image of the same size.

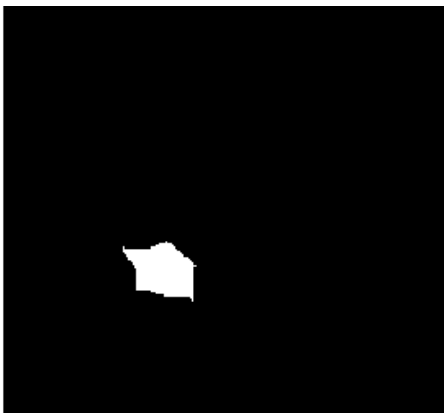

Fig10. Eroded Image

3.3 Result Analysis

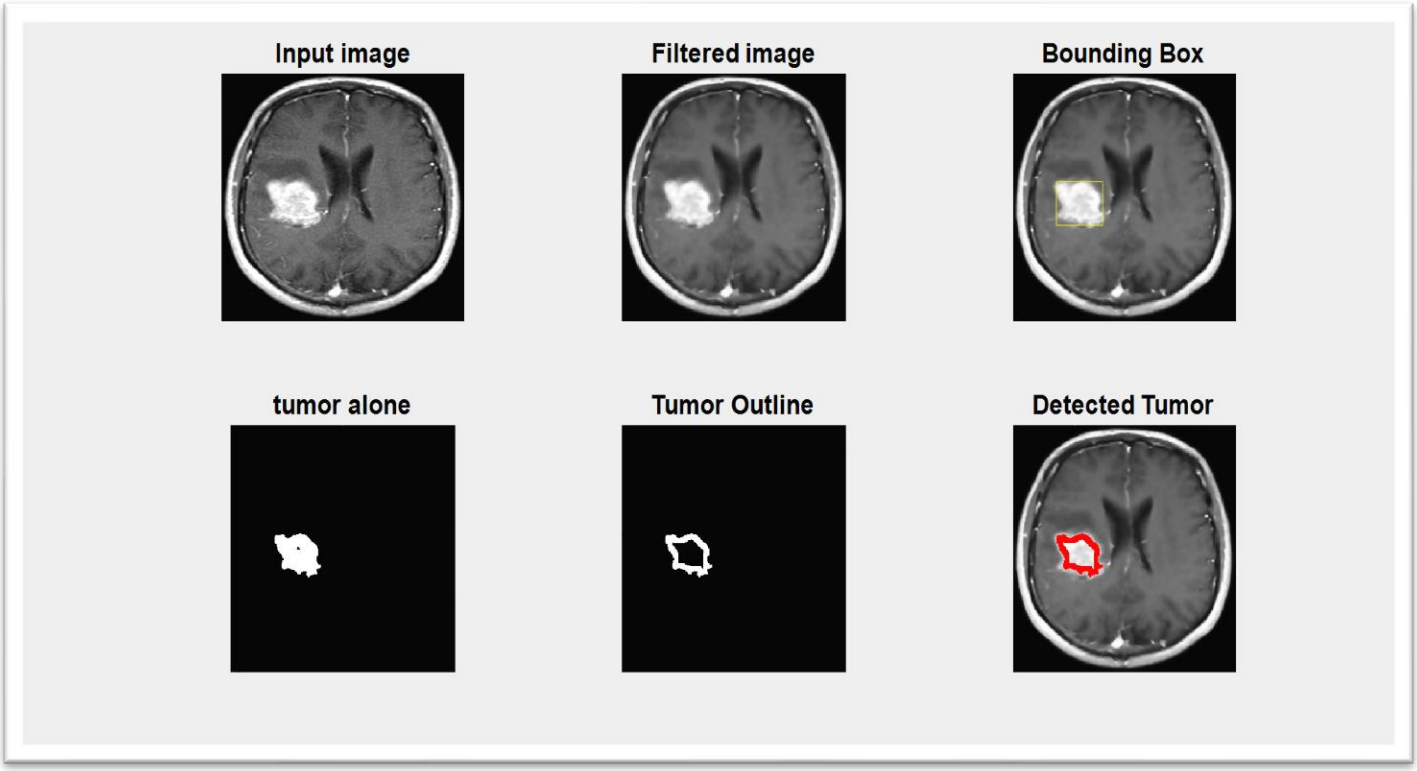

Fig11. Final Result

Conclusion

It is a system that can be used to segment MRI images of the brain to detect and identify a brain tumor. This system determines the size of the tumor with maximum precision. In this project, we have automated the procedure for diagnosing a brain tumor using image processing. In addition to several techniques for segmentation and detection of brain tumors for MRI images of the brain, it shows an overall accuracy of up to 95%. Enhancement and filtering are important because sharpening edges, enhancing, removing noise, and removing unwanted background improves image quality, as well as detection classification-based segmentation, which accurately segments the tumor and yields reasonable results for a large set of information, however unwanted behavior can occur if the category is not represented in the training data. These classification methods can first determine if a tumor is present or not, and if there is one, they can determine if a tumor is present or not.

The possibilities for detecting a brain tumor in the future are that if we get a 3-dimensional image of the brain with the tumor then we can also estimate the type of tumor as well as the stage of the tumor.

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