UNITED INSTITUTE OF TECHNOLOGY PRAYAGRAJ
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Department of Computer Science Engineering

A

Project Synopsis

on

Brain Tumor Detection Using Deep Learning

Under The Guidance Of

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1 Abstract

Now a day's tumor is second leading cause of cancer. Due to cancer large no of patients are in danger. The medical field needs fast, automated, efficient and reliable technique to detect tumor like brain tumor. Detection plays very important role in treatment. If proper detection of tumor is possible then doctors keep a patient out of danger. Various image processing techniques are used in this application. Using this application doctors provide proper treatment and save a number of tumor patients. A tumor is nothing but excess cells growing in an uncontrolled manner. Brain tumor cells grow in a way that they eventually take up all the nutrients meant for the healthy cells and tissues, which results in brain failure. Currently, doctors locate the position and the area of brain tumor by looking at the MR Images of the brain of the patient manually. This results in inaccurate detection of the tumor and is considered very time consuming. A tumor is a mass of tissue it grows out of control. We can use a Deep Learning architectures CNN (Convolution Neural Network) generally known as NN (Neural Network) and VGG 16(visual geometry group) Transfer learning for detect the brain tumor. The performance of model is predict image tumor is present or not in image. If the tumor is present it return yes otherwise return no.

2 Literature Review

In literature, machine learning, deep learning in particular, has been argued to have the potential of overcoming the challenges associated with the detection and intervention of brain tumor.

Deep Learning is regarded as one of the best methods in data science and artificial intelligence to train models through data to develop valuable decision-making abilities.

3 Introduction

3.1 Purpose

The human body is made up of many organs and brain is the most critical and vital organ of them all. One of the common reasons for dysfunction of brain is brain tumor. A tumor is nothing but excess cells growing in an uncontrolled manner. Brain tumor cells grow in a way that they eventually take up all the nutrients meant for the healthy cells and tissues, which results in brain failure. Currently, doctors locate the position and the area of brain tumor by looking at the MR Images of the brain of the patient manually. This results in inaccurate detection of the tumor and is considered very time consuming. A Brain Cancer is very critical disease which causes deaths of many individuals. The brain tumor detection and classification system is available so that it can be diagnosed at early stages. Cancer classification is the most challenging tasks in clinical diagnosis. This project deals with such a system, which uses computer, based procedures to detect tumor blocks and classify the type of tumor using Convolution Neural Network Algorithm for MRI images of different patients. Different types of image processing techniques like image segmentation, image enhancement and feature extraction are used for the brain tumor detection in the MRI images of the cancer-affected patients. Detecting Brain tumor using Image Processing techniques its involves the four stages is Image Pre-Processing, Image segmentation, Feature Extraction, and Classification. Image processing and neural network techniques are used for improve the performance of detecting and classifying brain tumor in MRI images

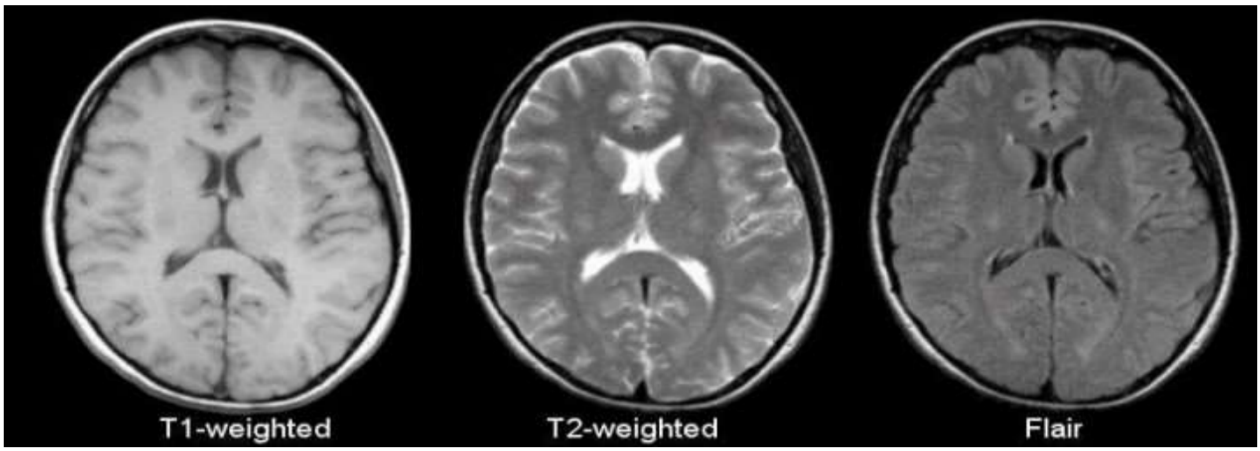
OVERVIEW OF BRAIN AND BRAIN TUMOR

Main part in human nervous system is human brain. It is located in human head and it is covered by the skull. The function of human brain is to control all the parts of human body. It is one kind of organ that allows human to accept and endure all type of environmental condition. The human brain enables humans to do the action and share the thoughts and feeling. In this section we describe the structure of the brain for understanding the basic things

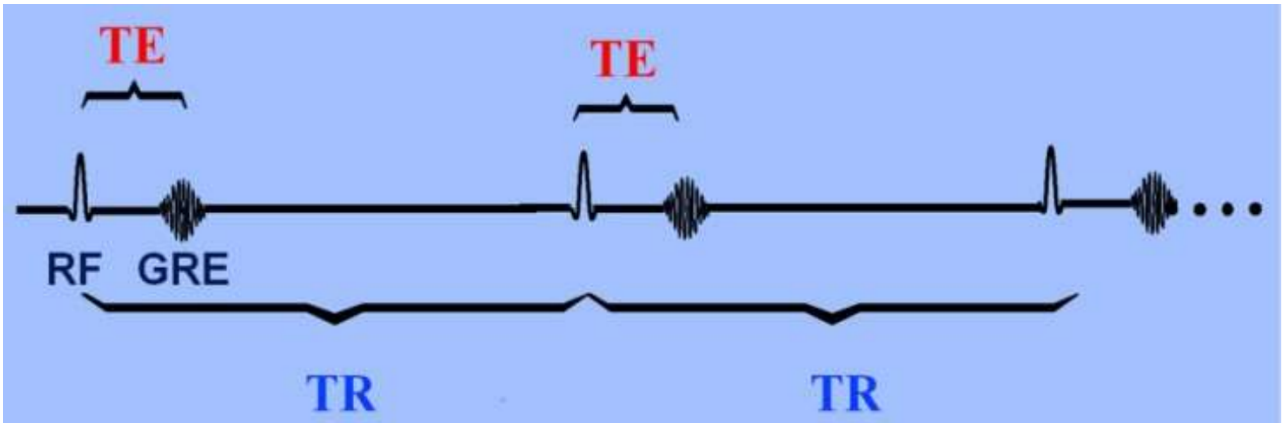
The brain tumors are classified into mainly two types: Primary brain tumor (benign tumor) and secondary brain tumor (malignant tumor).The benign tumor is one type of cell grows slowly in the brain and type of brain tumor is gliomas. It originates from non neuronal brain cells called astrocytes. Basically primary tumors are less aggressive but these tumors have much pressure on the brain and because of that, brain stops working properly . The secondary tumors are more aggressive and more quick to spread into other tissue. Secondary brain tumor originates through other part of the body. These type of tumor have a cancer cell in the body that is metastatic which spread into different areas of the body like brain, lungs etc. Secondary brain tumor is very malignant. The reason of secondary brain tumor cause is mainly due to.

MAGNETIC RESONANCE IMAGING (MRI)

Raymond v. Damadian invented the first magnetic image in 1969. In 1977 the first MRI image were invented for human body and the most perfect technique. Because of MRI we are able to visualize the details of internal structure of brain and from that we can observe the different types of tissues of human body. MRI images have a better quality as compared to other medical imaging techniques like X-ray and computer tomography.[8]. MRI is good technique for knowing the brain tumor in human body. There are different images of MRI for mapping tumor induced Change including T1 weighted, T2 weighted and FLAIR (Fluid attenuated inversion recovery) weighted shown in figure



The most common MRI sequence is T1 weighted and T2 weighted. In T1 weighted only one tissue type is bright FAT and in T2 weighted two tissue types are Bright FAT and Water both. In T1 weighted the repetition time (TR) is short in T2 weighted the TE and TR is long. The TE an TR are the pulse sequence parameter and stand for repetition time and time to echo and it can be measured in millisecond(ms)[9]. The echo time represented time from the centre of the RF pulse to the centre of the echo and TR is the length of time between the TE repeating series of pulse and echo is shown in figure

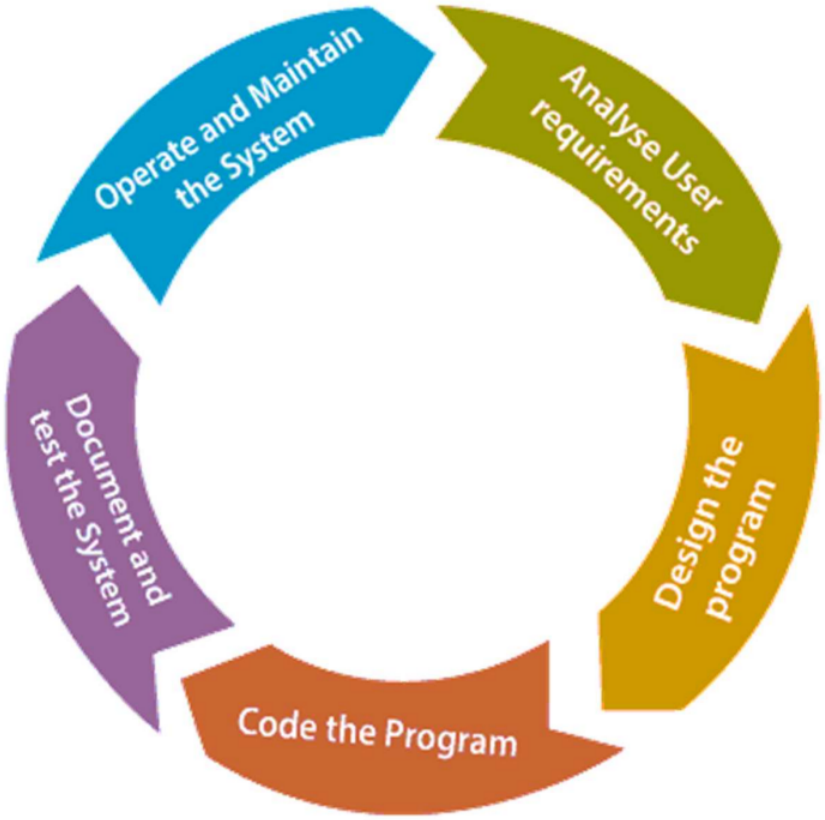


The third commonly used sequence in the FLAIR. The Flair sequence is almost same as T2-weighted image. The only difference is TE and TR time are very long. Their approximate TR and TE times are shown in table.

	TR (msec)	TE (msec)
T1-Weighted (short TR and TE)	500	14
T2-Weighted (long TR and TE)	4000	90
Flair (very long TR and TE	9000	114

3.1.1 Design Model

- Agile Model



1. Requirements gathering and analysis
In this phase, you must define the requirements. You should explain business opportunities and plan the time and effort needed to build the project. Based on this information, you can evaluate technical and economic feasibility.

2. Design the requirements
When you have identified the project, work with stakeholders to define requirements. You can use the user flow diagram or the high-level UML diagram to show the work of new features and show how it will apply to your existing system.

3. Construction/ Iteration
When the team defines the requirements, the work begins. The designers and developers start working on their project. The aims of designers and developers deploy the working product within the estimated time. The product will go into various stages of improvement, so it includes simple, minimal

functionality.

4.Deployment

In this phase, the team issues a product for the user's work environment.

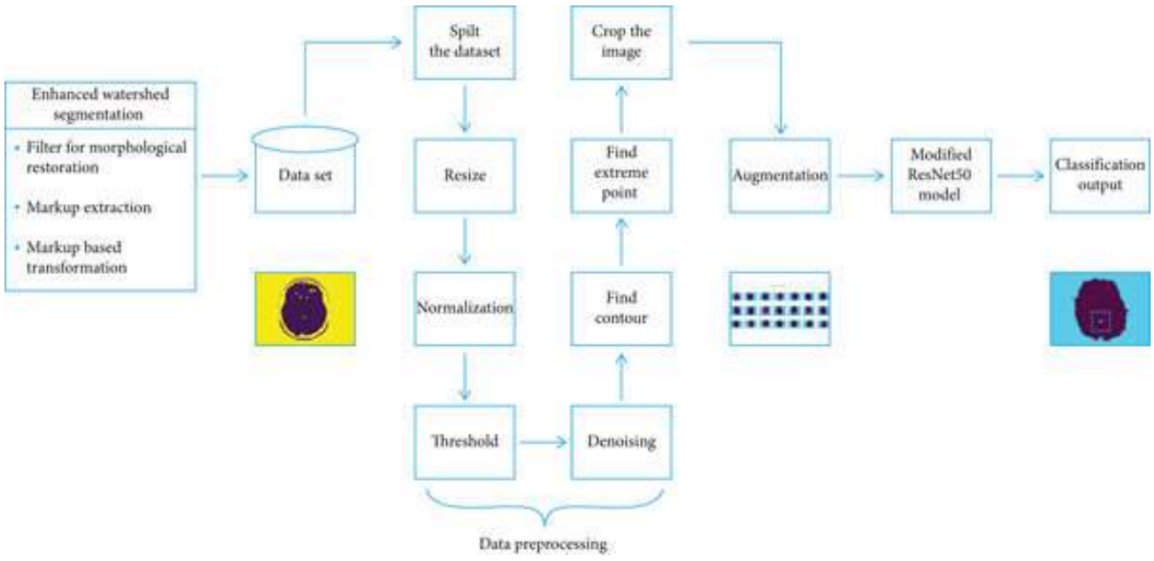
5. Testing

In this phase, the Quality Assurance team examine the product's performance and look for the bug.

6. Feedback

After releasing of the product, the last step is to feedback it. In this step, the team receives feedback about the produOverall Descriptions ct and works through the feedback.

Data Flow Diagram



3.2 Document Conventions

This document was based on the IEEE template for System Requirement Specifications Documentations

3.3 Intended audience Suggestions

Audience of this SRS are other projects developer, users like student, viewers that will use System. This SRS contain detail description about the product, its Functionality, different external interface required , System features, Nonfunctional requirements and some additional requirements.

3.4 Product scope

The main motivation behind Brain tumor detection is to not only detect tumor but it can also classify types of tumor. So it can be useful in cases such as we have to sure the tumor is positive or negative, it can detect tumor from image and return the result tumor is positive or not. This project deals with such a system, which uses computer, based procedures to detect tumor blocks and classify the type of tumor using Convolution Neural Network Algorithm for MRI images of different patients.

4 Overall Descriptions

4.1 Product Perspectives

The main aim is to design a system is to predict whether the person is suffering from the brain tumour or not In this process it collect the various type of images which contain the T1 weight images, T2 weight images and Flair images and then pass through the Convolution Neural network (CNN) for the Segmentation and feature extraction and Data Augumentation for training the data set.

4.2 Product Functions

Collect the images from the webscraping, api, images datasets from the Kaggle.

It includes the Data Cleaning and Data preprocessing which include the process of TF dataset(Tensorflow dataset pipelining) and the Data Augumentation, Morphological operation, Feature Extraction

we are having dataset previously collected brain MRIs from which we are extracting features.

4.3 User Classes and characteristics

Identify the various user classes that you anticipate will use this product. User classes may be differentiated based on the frequency of use, a subset of product functions used, technical expertise, security or privilege levels, educational level, or experience. Describe the pertinent characteristics of each user class. Certain requirements may pertain only to certain user classes. Distinguish the most important user classes for this product from those who are less important to satisfy.

User: User can capture or upload image and view result.

Admin: These user has an authority to update , delete and train sample image(training dataset).

4.4 Operating environment

Our Project is based Cloud and user application run on any web browser and plateform. So, we need desktop or android smartphone to run an application.

Window 10

Window 11

Linux

4.5 Design and Implementations Constraints

This project is developed in Python, it runs on Google collabs and Jupyter Notebook. It is wrapped into separate modules where each module and each module are linked with each other, where we create various modules of python which include the tensorflow , tf server , and many Model optimization technique.

4.6 User Documentations

The Software is uploaded on the open-source platform on google Collaboratory

4.7 Assumptions and Dependencies

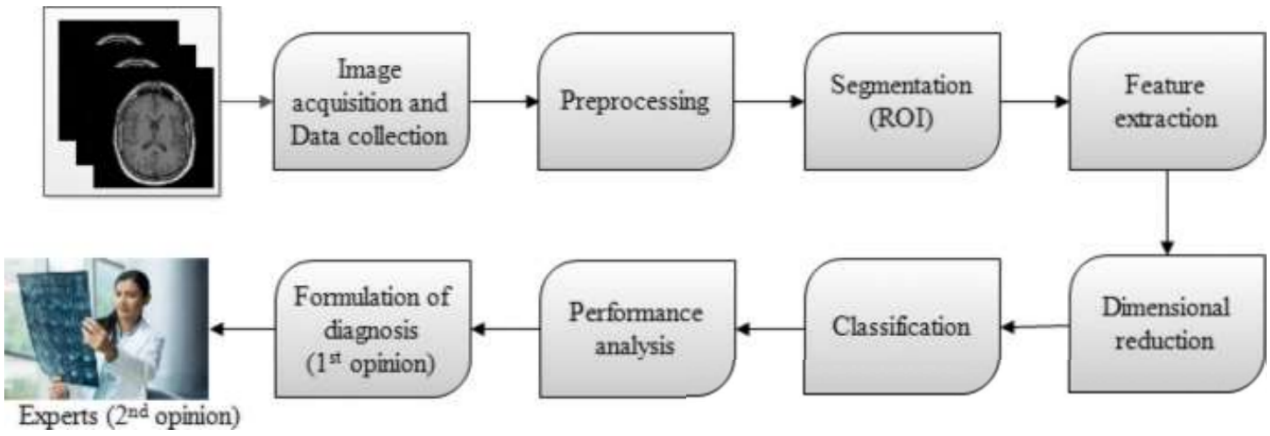
Leaf disease detection is developed in Python. Python must be installed on the user System. The Jupyter Notebook installed all the machine Learning Libraries and the Deep learning libraries.

5 Project Requirements

5.1 User Interface Requiremnets

1.Images collection as Tensorflow TF

In this process the cateogorical images of the leaf which include the healthy images , T1 weight images, T2 images can be inserted from the local memory to the tensorflow modules in the form of batches . in this process we use the batch processing technique in which the data is being taken from the local memory in the batches.



2.Preprocessing

Images come in different shapes and sizes. They also come through different sources. For example, some images are what we call "natural images", which means they are taken in color, in the real world. For example:

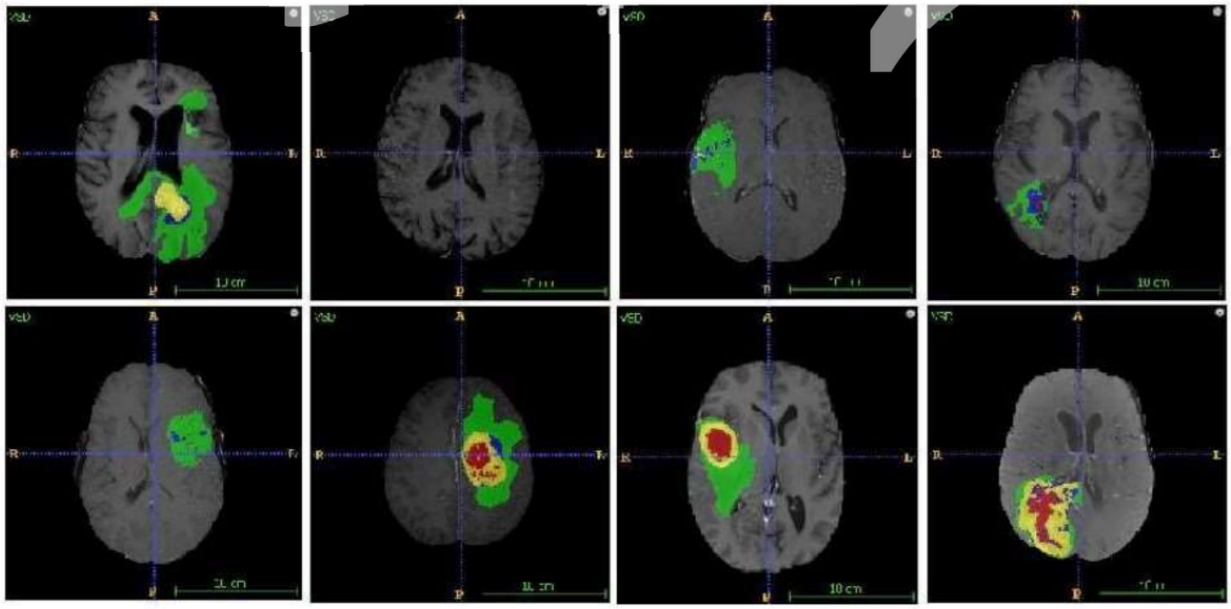
A picture of a flower is a natural image.

An X-ray image is not a natural image. Taking all these variations into consideration, we need to perform some pre-processing on any image data. RGB is the most popular encoding format, and most "natural images" we encounter are in RGB. Also, among the first step of data pre-processing is to make the images of the same size. Let's move on to how we can change the shape and form of images **Morphological Transformations**

The term morphological transformation refers to any modification involving the shape and form of the images. These are very often used in image analysis tasks. Although they are used with all types of images, they are especially powerful for images that are not natural (come from a source other than a picture of the real world).

1.Thresholding

one of the simpler operations where we take all the pixels whose intensities are above a certain threshold and convert them to ones; the pixels having value less than the threshold are converted to zero. This results in a binary image.



2.Erosion, Dilation, Opening Closing
Erosion shrinks bright regions and enlarges dark regions. Dilation on the other hand is exact opposite side — it shrinks dark regions and enlarges the bright regions.

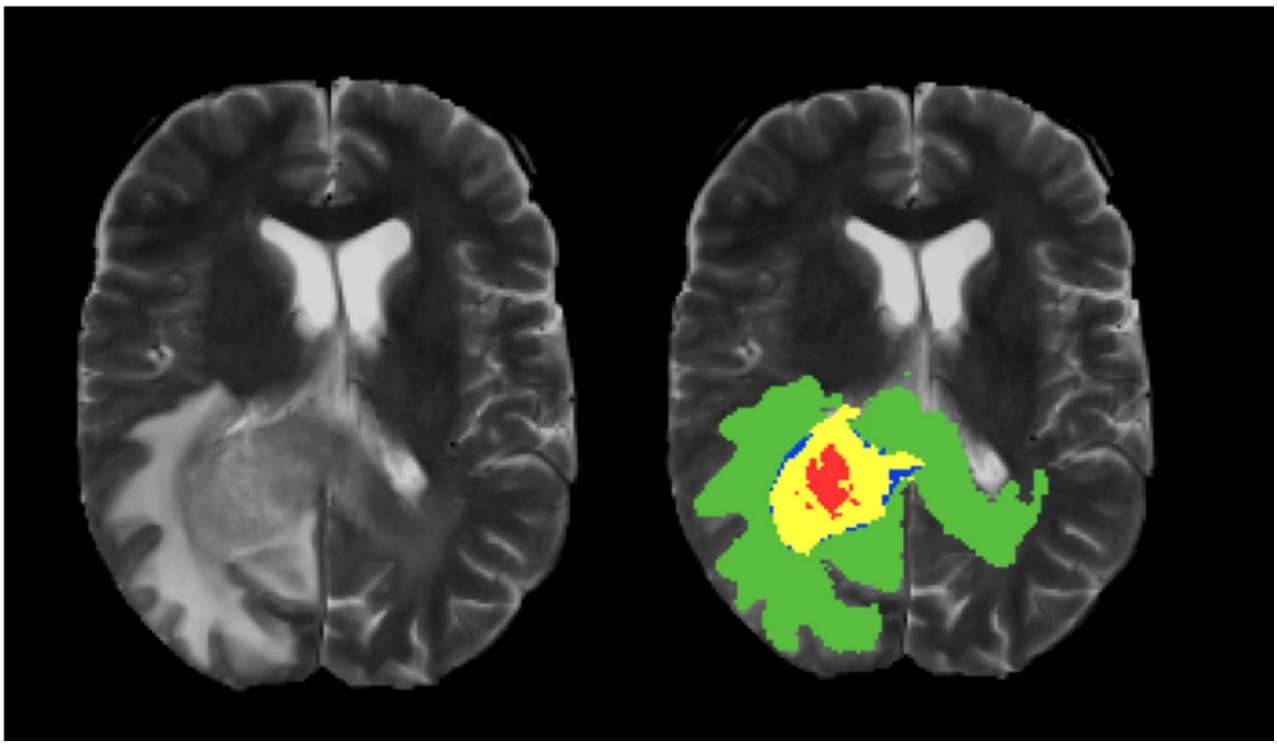
Opening is erosion followed by dilation. Opening can remove small bright spots (i.e. "salt") and connect small dark cracks. This tends to "open" up (dark) gaps between (bright) features.

Closing is dilation followed by erosion. Closing can remove small dark spots (i.e. "pepper") and connect small bright cracks. This tends to "close" up (dark) gaps between (bright) features.

All these can be done using the skimage.morphology module. The basic idea is to have a circular disk of a certain size (3 below) move around the image and apply these transformations using it.

3.Segmentation

Segmentation: Region growing is the simple region-based image segmentation technique. It is also classified as a pixel based image segmentation technique since it is involve the selection of initial seed points.



4.Feature Extraction

We apply machine learning to analyze a growing volume of data, which is becoming increasingly complicated. The emergence of deep learning during the past decade has undoubtedly helped generate learning paradigms that are becoming more effective. Numerous machine-learning jobs seek to categorize difficulties. Since features are extracted from the input data, it can be considered as a novel representation of the data, particularly for this task. Subsequently, in addition to these features, which complete the job, a categorization method is learned. This method should be applied to unobserved data in the training stage period upon completion of the training. It ought to give a precise forecast of its response precisely and in this situation the class label. Frequently, and particularly until recent times, the features ex-

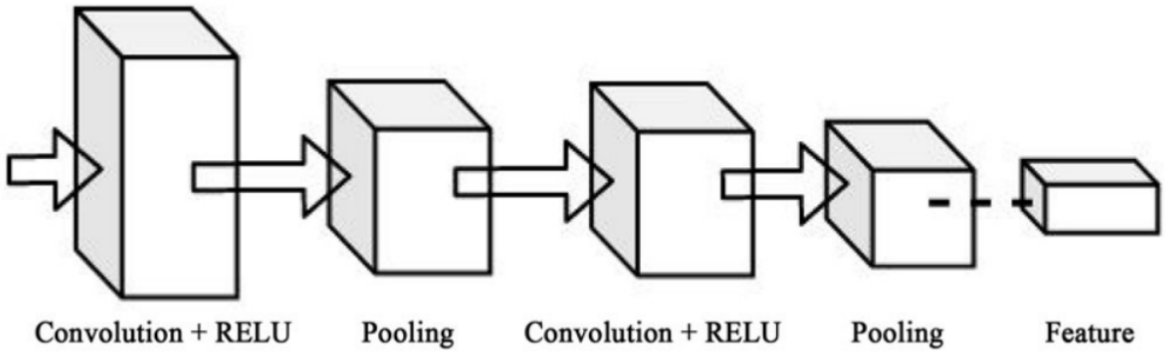
tracted from the input were handcrafted, implying that they are specially designed for the input data and the present task. It is standard practice for these not to be exclusively tied to the data type; for instance, handwritten images of words' pictures, but rather to a specific subset, such as English words handwritten in ink on parchment. Usually, most such features cannot manage change well; nevertheless, machine learning is a different method of extracting features from the data to learn a feature extractor.

Convolutional Neural Network (CNN)
convolutional layers store the output of the kernels from the previous layer which consists of weights and biases to be learned. The generated kernels that represent the data without an error is the point of the optimization function. In this layer, a sequence of mathematical processes is done to extract the feature map of the input image .exhibits the operation of the convolution layer for a 5x5 image input and aresult is a 3x3 filter that reduced to a smaller size . Also, the figure shows the shifting of filter starting from the upper left corner of the input image. The valuesfor each step are thenmultiplied by the values of the filter and the added values are the result. A new matrix with the reduced size is formed from the input image.

5. Dimension Reduction
The availability of high-dimensional medical image data during the identification procedure can place a heavy computational burden and require a suitable preprocessing step for lower-dimensional representation. At the same time, to reduce the storage requirement and complexity of the image data Random Projection Technique (RPT) is widely accepted as the multivariate approach for data reduction. Aims This paper mainly focuses on T1-weighted MRI images clustering for brain tumor segmentation with dimension reduction by using a conventional Principle Component Analysis (PCA) and RPT. Methods Two clustering algorithms, K-Means and Fuzzy C-Means, are used to detect the brain tumor. The primary objective is to present a comparison of two cluster methods between the PCA algorithm and RPT on MRIs. Apart from the original dimension of 512×512, the analysis used three other sizes, 256×256, 128×128, and 64×64, to study the effect of methods.

6. Classification
Classification is the final step of the image analysis method that involves

sorting feature data in an image into separate classes. After segmenting a suspicious region, feature extraction and selection scheme are performed to extract the relevant information from the region; and a classification technique is used so that the best results are achieved, based on the available features and the Tumor classes.



7. Performance Analysis

It needed to look into the most recent cutting-edge studies on brain tumor identification and tracking. This study evaluated recent papers published in the last decade or so that focused on the identification and categorization/classification of brain tumors employing CNN.

Current framework systems follow multiple pre-defined procedures to identify brain MRI images The effective mechanisms involved in recognizing and classifying tumor and non-tumor units in MRI brain imaging is covered in . The following is a brief overview of prospective approaches and strategies. Most images to be entered as input are MRI brain scans . Depending on the architecture and memory limitations, the input might be 2D or 3D. Due to its efficiency in significantly enhancing image data the input regarding images to be entered has proved to be as crucial as any other stage . Segmentation primarily divides the input image into identical sections depending

upon specified criteria, allowing only essential data to be extracted and the remainder to be discarded . There are numerous approaches. Some studies segment the actual tumor [48], whereas others segment the image region including the tumor . The goal of the classification stage is to divide the input data into various categories based on comparable behavior patterns inside the group. The third process described in the literature involves directly feeding brain MRI images to a Deep Learning program for categorization with no pre-processing. Statistical techniques or machine learning techniques are used to identify features. The Deep Learning algorithm is then trained using these extracted features. While deep learning methods do Appl. Sci. 2022, 12, 7282 8 of 20 not necessitate extraction of features, the study has shown that extracted features using machine learning, or meta-heuristic optimization methods, are still used in different models with reinforcement learning to include efficient and resilient features . Each plan's principal purpose is to change the levels of Supervised Learning based on the experimental criteria and then choose the model with the best performance. Using machine and Deep Learning approaches, researchers employed models to build efficient systems. The dataset is divided into learning, testing, and verification sets before beginning any of the approaches above. Convolutional Neural Network (CNN) has received substantial appreciation and recognition in Deep Learning for its ability to automatically extract and detect deep features by responding to tiny changes in images.

5.2 Hardware Interface

The minimum hardware requirement of the Application is a 500 Megahertz CPU and 500 megabytes of RAM. Also, because it uses the Deep Learning Concept where we use the computational power so we need a Compatible graphic card at least NVIDIA 1650. for the bigger Networks, additional memory is required

5.3 Software Interface

The application required python and Scikit-learn modules to be installed on the System, more specifically Python 3.6 version.

The project can be connected with the Deep Learning APIs and the API

for fetching the real time Photo.

5.4 Communication Interface

The project requires an internet connection to install new plugins, update already installed ones, and update some of its Components(APIs, modules, etc).

6 System Features

This section demonstrates the most prominent part of this Software where it tells us about the accuracy of the model that how much accuracy it performs for the training model and the testing model.

6.1 System feature

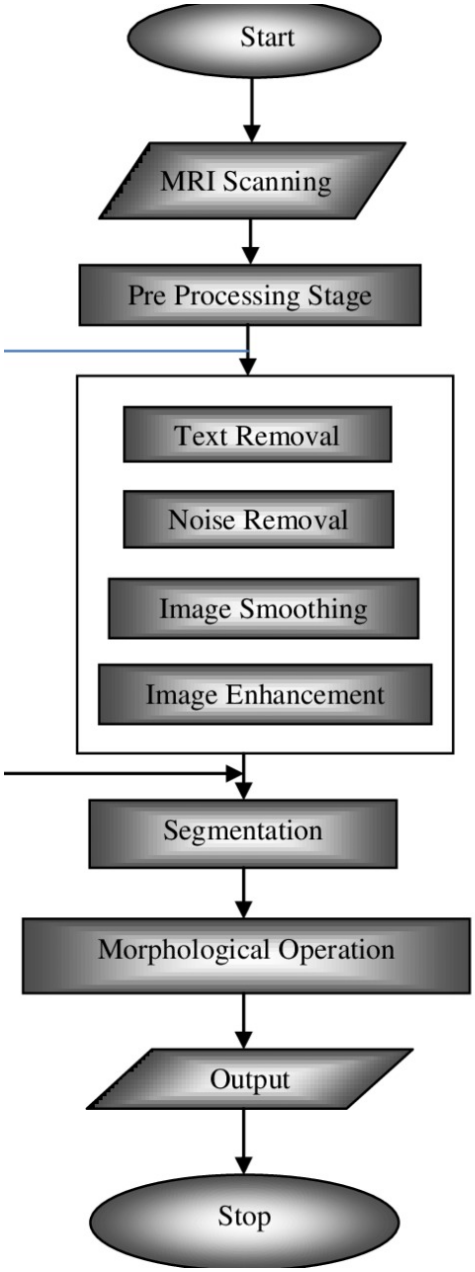
4.1.1.Description and priority
Detect The MRI whether the person has Tumor or Not.

4.1.2.Stimulus/Response Sequences

Give quick response when leaf capture.

Run system in using previously fetched dataset when not connected to cloud (Internet).

7 Activity Diagram



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