Project Report

On

BRAIN TUMOR DETECTION USING IMAGE PROCESSING

In partial fulfilment of requirements for the degree

Of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE & ENGINEERING

Submitted by:

CHETAN MALVIYA [18100BTCCE04026]

SIDDHARTH KHADELWAL [18100BTCSE02747]

VAIBHAV RAJ SISODIYA [18100BTCSE02762]

Under the guidance of

Ms. RUPALI DAVE

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE

SHRI VAISHNAV INSTITUTE OF INFORMATION TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

JULY – DEC 2021

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE
SHRI VAISHNAV INSTITUTE OF INFORMATION TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

DECLARATION

We here declare that work which is being presented in the project entitled **"BRAIN TUMOR DETECTION USING IMAGE PROCESSING"** in partial fulfilment of degree of **Bachelor of Technology in Computer Science & Engineering** is an authentic record of our work carried out under the supervision and guidance of **Ms. RUPALI DAVE** Asst. Professor of Computer Science & Engineering. The matter embodied in this project has not been submitted for the award of any other degree.

Chetan Malviya Signature

Siddharth Khandelwal Signature

Vaibhav Raj Sisodiya Signature

Date: 02/12/2021

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE
SHRI VAISHNAV INSTITUTE OF INFORMATION TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

PROJECT APPROVAL SHEET

Following team has done the appropriate work related to the **"Brain Tumor Detection Using Image Processing"** in partial fulfilment for the award of **Bachelor of Technology in Computer Science & Engineering** of "SHRI VAISHNAV INSTITUTE OF INFORMATION TECHNOLOGY" and is being submitted to SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE.

Team:

1. **Chetan Malviya**
2. **Siddharth Khandelwal**
3. **Vaibhav Raj Sisodiya**

Internal Examiner **External Examiner**

Date: 02/12/2021

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE
SHRI VAISHNAV INSTITUTE OF INFORMATION TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CERTIFICATE

This is to certify that **Mr. Chetan Malviya (18100BTCCE04026), Mr. Siddharth Khandelwal (18100BTCSE02747)** and **Mr. Vaibhav Raj Sisodiya (18100BTCSE02762)** working in a team have satisfactorily completed the project entitled **"BRAIN TUMOR DETECTION USING IMAGE PROCESSING"** under the guidance of Ms. Rupali Dave in the partial fulfilment of the degree of **Bachelor of Technology in Computer Science & Engineering** awarded by SHRI VAISHNAV INSTITUTE OF INFORMATION TECHNOLOGY affiliated to SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE during the academic year **July 2021 – Dec 2021.**

(Ms. Rupali Dave)
Project Guide

Prof. Chetan Chauhan
Project Coordinator

Dr. Anand Rajavat
Director & Head,
Department of Computer Science & Engineering

ACKNOWLEDGEMENT

We are grateful to a number of persons for their advice and support during the time of complete our project work. First and foremost our thanks goes to **Dr. Anand Rajavat** Head of the Department of Computer Science & Engineering and **Ms. Rupali Dave** the mentor of our project for providing us valuable support and necessary help whenever required and also helping us explore new technologies by the help of their technical expertise. His direction, supervision and constructive criticism were indeed the source of inspiration for us.

We would also like to express our sincere gratitude towards our Director **Dr. Anand Rajavat** for providing us valuable support.

We are really indebted to **Prof. Chetan Chauhan,** project coordinator for helping us in each aspect of our academics activities. We also owe our sincere thanks to all the **faculty members** of Computer Science & Engineering Department who have always been helpful.

We forward our sincere thanks to all **teaching and non – teaching staff** of Computer Science & Engineering department, SVVV Indore for providing necessary information and their kind co-operation.

We would like to thanks our parents and family members, our classmates and our friends for their motivation and there suggestion during the project. Last, but not the least, we thank all those people, who have helped us directly or indirectly in accomplishing this work. It has been a privilege to study at SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE.

ABSTRACT

Out of many diseases in medical science one of the rigorous problems, the World is facing today is Brain Tumor. Brain Tumor is an uncontrollable cell proliferation in the brain. Tumor can be detected using medical imaging techniques like Magnetic Resonance Imaging (MRI), But drawback is it cannot detect below 3 mm size. Hence for accurate analysis of Brain tumor, Segmentation is one of the tools that are extensively used in Medical Science. Segmentation is one of the methods to partition an image into regions. Segmentation discriminates healthy tissues from affected tissues. This makes easier for quantative analysis, accurate disease diagnosis, detection and classification of Brain tumor. As already lot of tumor segmentation methods are available, still more research should take place in this area. The reason is these MRI image display complex characteristics like high diversity in appearance of tumor and unclear tumor boundaries. Hence judicious disease diagnosis with scientific proof is essential. So that early planning can be done to save the life of patient. To facilitate the researchers working in this field, a review on various Brain Tumor segmentation is presented. The study emphasises the greater confrontation we come across while tumor Segmentation on various methods in the literature, as well. It is trusted that the methodologies and experiments put forth in this study will be of great use for researchers working in this field.

Automated defect detection in medical imaging has become the emergent field in several medical diagnostic applications. Automated detection of tumor in MRI is very crucial as it provides information about abnormal tissues which is necessary for planning treatment. The conventional method for defect detection in magnetic resonance brain images is human inspection. This method is impractical due to large amount of data. Hence, trusted and automatic classification schemes are essential to prevent the death rate of human. So, automated tumor detection methods are developed as it would save radiologist time and obtain a tested accuracy. The MRI brain tumor detection is complicated task due to complexity and variance of tumors. In this project, we propose the machine learning algorithms to overcome the drawbacks of traditional classifiers where tumor is detected in brain MRI using machine learning algorithms. Machine learning and image classifier can be used to efficiently detect cancer cells in brain through MRI.

LIST OF FIGURES

TABLE OF CONTENT

CHAPTER 1
INTRODUCTION

1. INTRODUCTION

1.1 Introduction

This project proposes two different methodologies to segment a tumor from an MRI image and determine the type of tumor. For this one segmentation and one clustering techniques have been implemented. Each MRI image is passed through an imaging chain where the image is preprocessed to remove noise and is further enhanced to improve the contrast of the image. This paper proposes two different techniques which are then applied on the image to extract the tumor. These segmentation techniques include SOM Clustering and SVM Classification. Applying each of the segmentation techniques allows us to determine the most appropriate method to segment the tumor from each of the images. The tumor region represents the pixel values for the foreground points extracted using the ginput() command from a texture image. The texture image is generated by applying the rangefilt() method. In order to enhance the texture characteristics of the image, smoothing filter is applied to the texture image. In this project, the major challenge faced was to locate and extract the proper tumor region from the image. Due to several lighting issues, unnecessary white portions were present in the image which could wrongly be segmented as a tumor. Also the unwanted noise and reduced contrast displays several regions from the image that are falsely claimed as a tumor. Another challenge faced was degraded quality of the MRI image due to several problems that would have occurred during the acquisition stage.

Brain tumor is one of the most rigorous diseases in the medical science. An effective and efficient analysis is always a key concern for the radiologist in the premature phase of tumor growth. Histological grading, based on a stereotactic biopsy test, is the gold standard and the convention for detecting the grade of a brain tumor. The biopsy procedure requires the neurosurgeon to drill a small hole into the skull from which the tissue is collected. There are many risk factors involving the biopsy test, including bleeding from the tumor and brain causing infection, seizures, severe migraine, stroke, coma and even death. But the main concern with the stereotactic biopsy is that it is not 100% accurate which may result in a serious diagnostic error followed by a wrong clinical management of the disease.

Tumor biopsy being challenging for brain tumor patients, non-invasive imaging techniques like Magnetic Resonance Imaging (MRI) have been extensively employed in diagnosing brain tumors. Therefore, development of systems for the detection and prediction of the grade of tumors based on

MRI data has become necessary. But at first sight of the imaging modality like in Magnetic Resonance Imaging (MRI), the proper visualisation of the tumor cells and its differentiation with its nearby soft tissues is somewhat difficult task which may be due to the presence of low illumination in imaging modalities or its large presence of data or several complexity and variance of tumors-like unstructured shape, viable size and unpredictable locations of the tumor.

Automated defect detection in medical imaging using machine learning has become the emergent field in several medical diagnostic applications. Its application in the detection of brain tumor in MRI is very crucial as it provides information about abnormal tissues which is necessary for planning treatment.Studies in the recent literature have also reported that automatic computerized detection and diagnosis of the disease, based on medical image analysis, could be a good alternative as it would save radiologist time and also obtain a tested accuracy. Furthermore, if computer algorithms can provide robust and quantitative measurements of tumor depiction, these automated measurements will greatly aid in the clinical management of brain tumors by freeing physicians from the burden of the manual depiction of tumors.

1.2 Problem Statement

Healthcare sector is totally different from other industry. It is on high priority sector and people expect highest level of care and services regardless of cost. After the success of deep learning in other real-world application, it is also providing exciting solutions with good accuracy for medical imaging and is a key method for future applications in health sector. Brain is an organ that controls activities of all the parts of the body. Recognition of automated brain tumor in Magnetic resonance imaging (MRI) is a difficult task due to complexity of size and location variability. In this research statistical analysis morphological and thresholding techniques are proposed to process the images obtained by MRI for Tumor Detection from Brain MRI Images. Feed-forward backprop neural network will be used to classify the performance of tumors part of the image. The results produced by this approach will increase the accuracy and reduce the number of iterations.

Brain tumors are a heterogeneous group of central nervous system neoplasms that arise within or adjacent to the brain. Moreover, the location of the tumor within the brain has a profound effect on the patient's symptoms, surgical therapeutic options, and the likelihood of obtaining a definitive

diagnosis. The location of the tumor in the brain also markedly alters the risk of neurological toxicities that alter the patient's quality of life.

At present, brain tumors are detected by imaging only after the onset of neurological symptoms. No early detection strategies are in use, even in individuals known to be at risk for specific types of brain tumors by virtue of their genetic makeup. Current histopathological classification systems, which are based on the tumor's presumed cell of origin, have been in place for nearly a century and were updated by the World Health Organization in 1999. Although satisfactory in many respects, they do not allow accurate prediction of tumor behaviour in the individual patient, nor do they guide therapeutic decision-making as precisely as patients and physicians would hope and need. Current imaging techniques provide meticulous anatomical delineation and are the principal tools for establishing that neurological symptoms are the consequence of a brain tumor.

There are many techniques for brain tumor detection. I have used edge detection technique for brain tumor detection.

1.3 Need for the Proper System

Brain tumor is considered as one of the aggressive diseases, every year, around 11,700 people are diagnosed with a brain tumor. The 5-year survival rate for people with a cancerous brain or CNS tumor is approximately 34 percent for men and 36 percent for women. The traditional way of curing it is quite expensive and there isn’t much online availability of any system which detects the Tumor in an MRI image. And if there exist any, either it is a computer software or a paid software, means the user requires a pc to check whether tumor is present or not. Thus, there need to be a system which scan provide users with the same facility and that too in a very easy, efficient way so that even a person without a proper system can predict the same, that too with his/her mobile phone.

1.4 Objective

Brain tumor occurs because of anomalous development of cells. It is one of the major reasons of death in adults around the globe. Millions of deaths can be prevented through early detection of brain tumor. Earlier brain tumor detection using Magnetic Resonance Imaging (MRI) may increase patient's survival rate. In MRI, tumor is shown more clearly that helps in the process of further treatment. This work aims to detect tumor at an early phase.

- Study and understand the literature that is based on image processing.
- Identify major areas of image processing in medicine and in particularly on brain tumor detection.
- Identify current issues in brain tumor identification.
- Propose future directions and improvements that can be made in this area.
- Critically analyze and review identification of brain tumor using image processing.

1.5 Module of System

The entire project is divided into 4 different components:

a) **The Workplace:** As the name suggest, yes, it is what it sounds like!! One of the front-end components of our project, and apparently the parent of all other components, workplace is a place where we ask user to upload the MRI image. The image then goes through our other components, i.e., the back-end ones which then reveals the prediction and the same is visible in this component itself.

b) **Image Verification Model:** The image uploaded by the user goes as an input in this model. The role of this model is to check the validity of that image, whether the uploaded image is MRI image or not, if yes, it passes the image to our next module, if not, we display an error message to the user, saying **'**INVALID IMAGE, looks like the image does not fulfil the requirements, please upload a valid MRI image!'. The module uses linear regression to predict whether the image is valid or not.

c) **Brain Tumor Detection Model:** The most important module of our project, the brain tumor detection model. As the name suggest, yes it detects the tumor and predicts the output result. We used SVM (Support Vector Machine) in the same and this model predicts the result with an accuracy of above 80%. If it predicts no tumor, we display 'No Tumor detected everything looks fine, stay safe :)'. But if it predicts that there's a tumor, we further predict the same and predict the type of tumor found, the types it predicts are Meningioma Tumor, Pituitary Tumor, and Glioma Tumor. The results are then sent to our next module.

d) **Visualisation:** Once the tumor is detected, we convert the image into its heat map, and try to give a solid visualisation to the user, the heat maps are generated using matplotlib cmap. Four different effects are used so as to improve user experience and for better visualisation.

1.6 Scope

- Discuss about image processing techniques.
- Discuss about identification of brain tumor.
- Discuss about how to detect and identify brain tumor using image processing techniques.
- Discuss about the issues in the field.

CHAPTER 2
LITERATURE SURVEY

2. LITERATURE SURVEY

Swapnil R.Telrandhe, et.al Proposed 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. During this framework, edge detection is a vital tool for image segmentation. In this paper their effort was made to study the performance of most commonly used edge detection techniques for image segmentation and additionally the comparison of these techniques was carried out with an experiment.

Rajeshwari G tayade et.al, in their paper they gave a mixture of wavelet statistical features and co-occurrence wavelet texture feature obtained from two level distinct riffle remodel was used for the organization of abnormal brain matters in to benign and malignant. The planned system was consists of four stages: segmentation of region of interest, separate ripple disintegration, feature abstraction, feature choice, organization and analysis. The support vector machine was used for tumor segmentation. A grouping of WST and WCT was used for feature extraction of neoplasm region extracted from second level separate ripple remodel. Genetic algorithm was used to choose the best texture options from the set of well-mined options.

Malathi Hong-Long et.al, proposed approach by desegregation wave entropy based mostly spider net plots and probabilistic neural network for the classification of Brain MRI. Proposed technique uses two steps for classification one is wavelet entropy based mostly spider net plot for feature withdrawal and probabilistic neural network for classification. The obtained brain magnetic resonance image, the feature extraction was done by wavelet remodel and its entropy worth was calculated and spider net plot space calculation was done. With the assistance of entropy worth classification of probabilistic neural network was calculated. Probabilistic neural network provides a general resolution for pattern classification.

2.1 Existing System

Yes, there exist few Brain tumor detection systems, but almost all of them are either desktop application, or they chare for the same. The problem with the existing systems is that the user requires a desktop to check whether tumor is present or not, without a proper system he/she won't be able to operate the software and use the same for prediction. Another main issue is that, publicly only few are available, that too what we said above, for people, very few are open and aren't

private. No major or reputed company has such system open for people to use. The market seems to be void for such systems, and thus there isn't any competition in the market, or we can say that we don't have any major competitor with such system.

2.2 Proposed System

We propose a system which provides user the option to upload the MRI image in any image format and just press a button. We'll use our ML models to do the internal working and show the results to the user. All this will happen on a web application and thus none of the user is expected to have a desktop or any other major specific requirement to operate our system. Basic integrated device will smoothly run the application and the user can easily predict tumors here in the system. System posses a web application, where we ask user to upload the MRI image, this image will go though our validation model first, the role of this model is to check the validity of that image, whether the uploaded image is MRI image or not, if yes, it passes the image to our next module, if not, we display an error message to the user, saying **'**INVALID IMAGE, looks like the image does not fulfil the requirements, please upload a valid MRI image!'. After validation, the image will go into our second model, the detection one, it'll do all sort of prediction and gives the result, if there exist any tumor, the model will further predict the type of tumor exist. After which a proper visualisation will be provided to the user on the web application itself for better understanding of the tumor patch. All this will happen on a simple web app and that too free of cost.

2.3 Feasibility Study

Here, I will carry out a study to gain an understanding of the customer's current system and problems experienced in this system through observations, and participations. I will use the obtained data to determine the viability of the system being proposed in terms of technical, economical and operational feasibility.

2.3.1 Technical Feasibility

Project **Brain Tumor Detection Using Image** is a complete web-based application. The main technologies and tools that are associated with Brain Tumor Detection Using Image are:

- Python
- Flask
- JavaScript
- Jupyter Notebook
- Diagram Drawing Tools:
    - StarUML

Each of the technologies are freely available and the technical skills required are manageable. Time limitations of the product development and the ease of implementing using these technologies are synchronized.

Initially the web site will be hosted in a free web hosting space, but for later implementing it will be hosted in paid web hosting space with a sufficient bandwidth. Bandwidth required in this application is very low, since it doesn't incorporate any multimedia aspect.

2.3.2 Economical Feasibility

- **Development Cost**
    - Equipment's required for developing the software are easily available.
    - Equipment maintenance is also minimum.
    - Saving of paperwork and manpower reduced.
- **Benefits which cannot be measured**
    - Increased customer loyalty.
    - Increased customer satisfaction.

2.3.3 Operational Feasibility

Proposed system is beneficial only if it can be turned into system that will meet the need of the clients operating requirement and work is increasing day – by – day.

The proposed system is operationally feasible due to the following reasons:

- The System is easy to use and is very simple.

- The proposed system will cost no harm to the company; instead, it will enhance the result in a better respect.

The new system will avoid confusion and resistance by catching the user's attention, as it is presentable.

CHAPTER 3

REQUIREMENTS ANALYSIS

3. REQUIREMENTS ANALYSIS

Requirements Analysis or requirements engineering is a process used to determine the needs and expectations of a new product. It involves frequent communication with the stakeholders and end-users of the product to define expectations, resolve conflicts, and document all the key requirements.

One of the greatest challenges faced by any organization is to share the vision of the final product with the customers. Hence, a business requirements analysis involves a team effort of all the key stakeholders, software developers, end-users, and customer managers to achieve a shared understanding of what the product should do. This is always done in the early phase of any project to ensure that the final product conforms to all the requirements.

At this stage, I will gather information about what the customer needs and define the problems the system is expected to solve. I will also include customer business context, products functions and its compatibility. I will gather requirement such as software like the programming language to use, database model and hardware needed such as laptop, printers etc.

Requirement analysis involved defining customer needs and objectives in the context of planned customer use, environments and identified system characteristics to determine requirements for system functions.

3.1 Method Used for Requirement Analysis

For requirement analysis we use data flow diagram technique for gathering requirements.

Data flow diagram: Data flow diagrams give information about how the data is processed by a given system in terms of outputs and inputs. There are four components of a data flow diagram namely Flow, Process, Terminator and Store. There are also two types of data flow diagram namely physical data flow diagram and logical data flow diagram. The physical data flow diagram shows the infrastructure of a system while the logical data flow diagram shows the activities of the system. It can be designed early in the process of requirement elicitation within the Software Development Life Cycle (SDLC) to define the scope of the project. It can also be divided into sub-processes known as ‘levelled data flow diagram DFD’ for easy analysis.

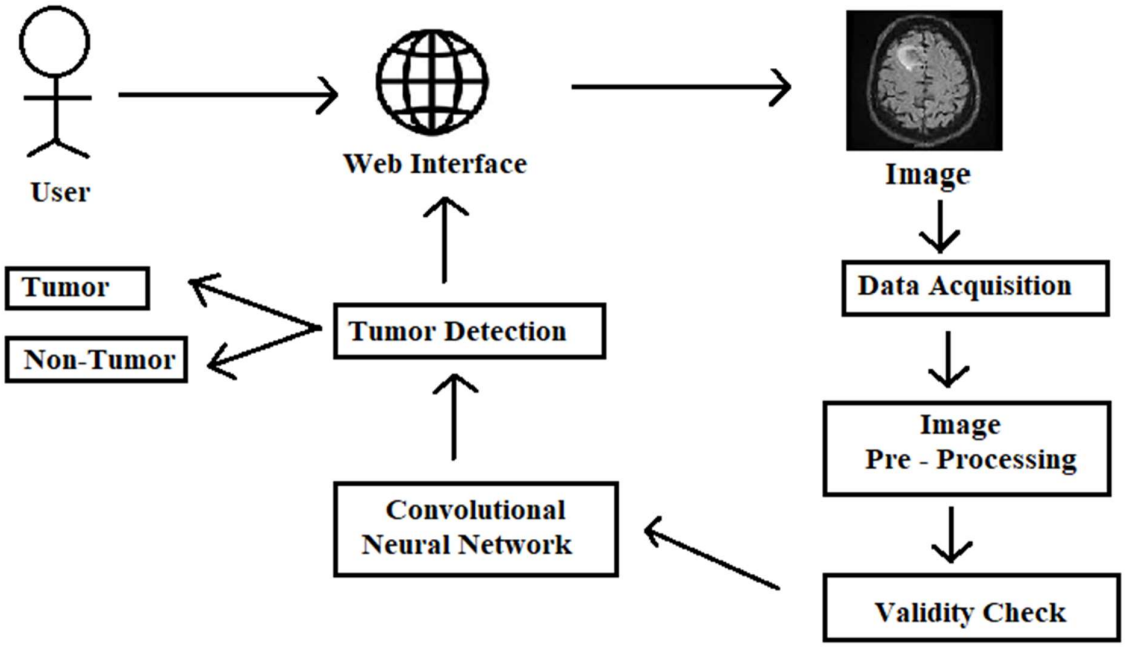


Figure 3.1.1: Data Flow Diagram

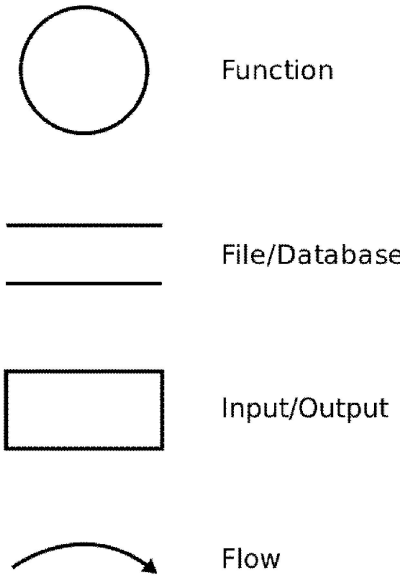


Figure 3.1.2

3.2 Data Requirements

The most important data for us is our dataset, without which both our ML models will not predict anything. So, the basic data requirement of our system to work is the dataset. Secondly, we ask user to upload the MRI image, which will then be given to our models to predict. So, from user's perspective, we only want the MRI image from the user and that's it, that's all about out data requirement.

3.3 Functional Requirement

The functional requirements in our system are divided into different type of functional according on actors who using our system. We have one actor using our Medical Image Processing system (User). The points below describe all functional requirements for user:

- The user shall be able to select MRI scan images for patients.
- The user shall be able to upload MRI scan images for patients.
- The user shall be able to view segmentation results.
- The user shall be able to view brain tumor detection.
- The MRI Image must not contain any irrelevant object in order for a successful Diagnosis.
- Image to statistical data converter working in backend.

3.4 Non-Functional Requirement

We will describe here the non-functional requirements for our system:

- **Usability:** The proposed systems easy to use for user.
- **Performance:** The proposed system is working harmoniously and hierarchically for MRI scan images for different patients, and for the accuracy of result for brain tumor detection.
- **Scalability:** The capability of proposed system to handle a growing amount of patients and MRI scan images, or its potential to be enlarged in order to accommodate that growth.
- Other than MRI images, no other data will be collected.
- System should accept images of all types.
- No user authentication and the images won't be stored, thus highly secure.

- Minimal dependency on the webpages, so as to reduce the load time and increase user experience.

3.5 System Specification

3.5.1 Hardware Specification

- **OS:** Windows 10
- **Processor:** Intel Core i3 or Higher
- **RAM:** 4GB or Higher
- **Hard Disk:** 500GB or Higher

3.5.2 Software Specification

- **Technology**
  Backend (Model Implementation): Python
  Web Integration: Flask, JavaScript
- **IDE:** Jupyter Notebook, Visual Studio Code
- **Microsoft Office PowerPoint:** Used during Presentation
- **Star UML:** SRS Diagram

CHAPTER 4
DESIGN

4. DESIGN

4.1 Software Requirements Specification

Software Requirement Specification (SRS) Format as name suggests, is complete specification and description of requirements of software that needs to be fulfilled for successful development of software system. These requirements can be functional as well as non-requirements depending upon type of requirement. The interaction between different customers and contractor is done because it's necessary to fully understand needs of customers.

4.1.1 Glossary

Astrocytoma: A subtype of **glioma** that has features in common with astrocytes; an astrocyte is a subtype of glial cell that has a variety of functions in the brain, including reacting and filling space after an area of injury and regulating the blood brain barrier.

Central Nervous System (CNS): A complex organ system that includes the brain and spinal cord.

Cerebrospinal Fluid (CSF): Fluid that surrounds the brain and spinal cord and fills the **ventricles**. Some malignant brain tumor types have a propensity to spread through this fluid, and cells of these tumors may be identified through microscopic analysis.

Embryonal Tumors: Group of malignant tumors that are most common in children and young patients. They share features in common with the developing **Central Nervous System**.

Ependymoma: Subgroup of tumors that have are most common in the brain in children and the spinal cord in adults. They form well circumscribed masses and the primary treatment involves surgical resection, although chemotherapy and irradiation may be required for higher grade tumors.

Epilepsy: A disorder of the brain characterized by recurrent convulsions (seizures).

Fluorescence in situ hybridization (FISH): Molecular technique that applies "probes" for specific gene regions and is useful in identifying gains (amplifications) and gene losses (e.g. 1p/19q) in tumors.

Glia: Generic term for supporting cells in the **Central Nervous System** other than neurons. It includes astrocytes, oligodendrocytes and microglia.

Glioblastoma: Most common primary malignant brain neoplasm characterized by its aggressive behavior and infiltrative behavior in the brain.

Glioma: Broad category of brain tumors that includes astrocytomas and oligodendrogliomas.

Grade: Scale used to assess the potential aggressiveness of brain tumors. Brain tumors may be broadly classified as **low grade** or **high grade**.

High Grade: Applied to tumors with a high proliferative rate and malignant features.

IDH1: Isocitrate dehydrogenase 1. Metabolic enzyme. Mutations in this gene are a feature of a diffuse glioma subset associated with a better prognosis.

Immunohistochemistry: Special staining technique that recognizes the levels of specific molecules, such as proteins, characteristic of particular tumor types.

Immunosuppression: The partial or complete suppression of the immune response of an individual; immunosuppression is induced to help the survival of an organ after a transplant operation.

Low Grade: Applied to tumors usually with a slower growth potential.

Medulloblastoma: Most common primary malignant brain tumor in children. Highly aggressive but many patients are curable with current treatments.

Meninges: Tissues that cover and surround the brain and contain the cerebrospinal fluid.

Meningioma: Common brain tumor that develops in association with **meninges** and may compress the brain or spinal cord from the outside.

Metastases: Tumors that start outside of the brain in other organs (e.g. lung, breast) but that reach the brain through the circulation.

MGMT Methylation: Molecular genetic characteristic of specific subgroups of brain tumors—particularly glioblastoma—and associated with a higher sensitivity for specific chemotherapies (such as temozolomide).

Microvascular Proliferation: Increased number and abnormal configuration of small vessels in brain tumors. A marker of higher grade in diffuse gliomas.

Mutation: Alterations in the DNA of specific genes. May characterize specific brain tumor types. Mutations may be somatic (present in the tumor tissue only) or germline (present in multiple or all cells of the patient as well as the tumor).

Necrosis: Areas of dead cells or tissues. Necrosis is a marker of higher grade in diffuse **gliomas**.

Neurooncologists: Physicians specializing in the medical treatment of brain tumors.

Next Generation Sequencing: Laboratory technique that allows for the testing of alterations of multiple genes simultaneously. Increasingly applied to tumor diagnosis and treatment.

Oligodendrogliomas: Glioma subtype characterized by particular morphologic features (uniform round cells) and molecular genetic alterations (**1p/19q codeletion, IDH** mutation) and associated with relatively better outcome among the diffuse gliomas affecting adults.

Polymerase Chain Reaction (PCR): Common laboratory technique used to test alterations in specific genes.

Ventricles: Cavities located inside the brain containing the **cerebrospinal fluid**.

WHO Classification: Standard guide for the classification and grading of human cancer, including brain tumors. Guidelines are established by brain tumor experts from around the world every few years.

4.1.2 Supplementary Specifications

Functionality

- The user shall be able to select MRI scan images for patients.
- The user shall be able to upload MRI scan images for patients.
- The user shall be able to view segmentation results.
- The user shall be able to view brain tumor detection.
- The MRI Image must not contain any irrelevant object in order for a successful Diagnosis.
- Image to statistical data converter working in backend.

Usability

The proposed systems easy to use for user.

Scalability

The capability of proposed system to handle a growing amount of patients and MRI scan images, or its potential to be enlarged in order to accommodate that growth.

Windows Compliance

The desktop user-interface shall be windows 95/98 compliant.

Design for Ease-of-User

The user interface of the C-Registration System is designed for ease-of-use and shall be appropriate for a computer-literate user community with no additional training on the System.

Reliability

This section lists all reliability requirements.

Availability

The C-Registration System shall be available 24 hours a day, 7 days a week. There shall be no more than 4% down time.

Performance

The proposed system is working harmoniously and hierarchically for MRI scan images for different patients, and for the accuracy of result for brain tumor detection.

Design Constraints

This section lists any design constraints on the system being built.

Platform Requirements

- **OS:** Windows 10
- **Processor:** Intel Core i3 or Higher
- **RAM:** 4GB or Higher
- **Hard Disk:** 500GB or Higher

Internet Browsers

The web-base interface for the C-Registration System shall run in Google Chrome 91.0.4472.101 browsers.

Python Compatibility

The web-based interface shall be compatible with the Python 3.4 runtime environment.

4.1.3 Use Case Model

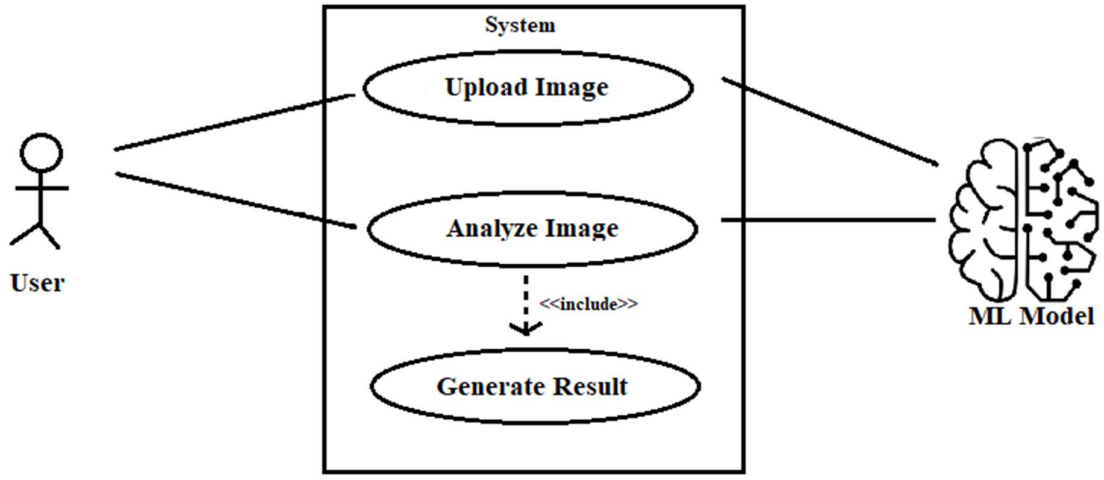


Figure 4.1.3: Use Case Model

4.2 Data Flow Diagram

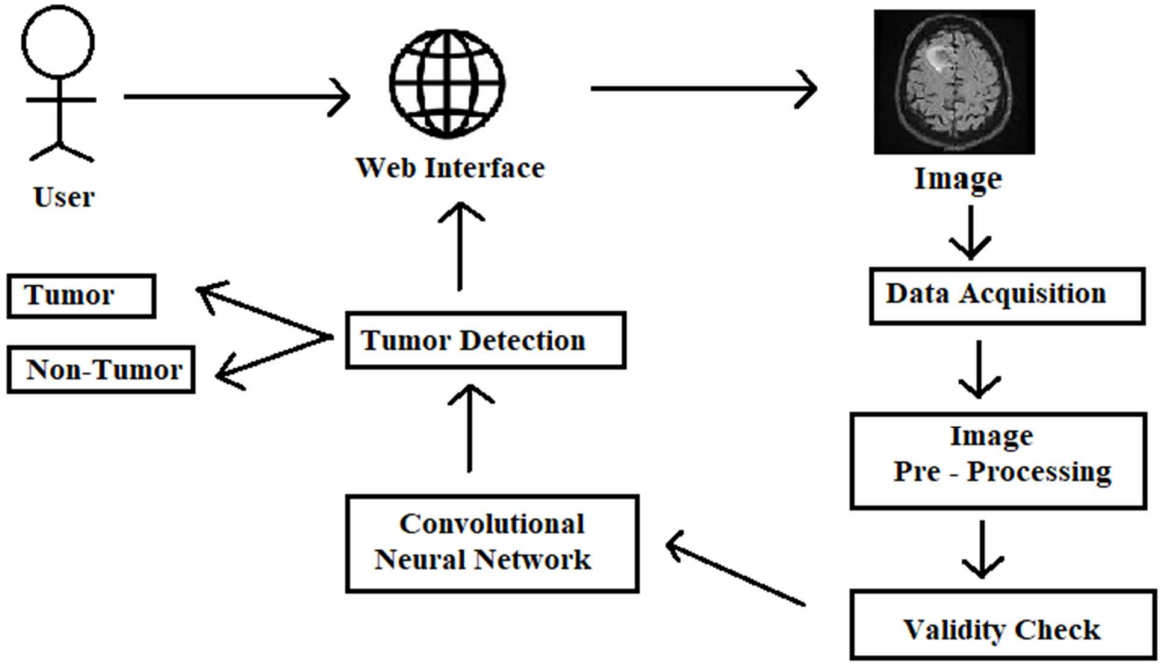


Figure 4.2: Data Flow Diagram

4.3 Flow Chart Diagram

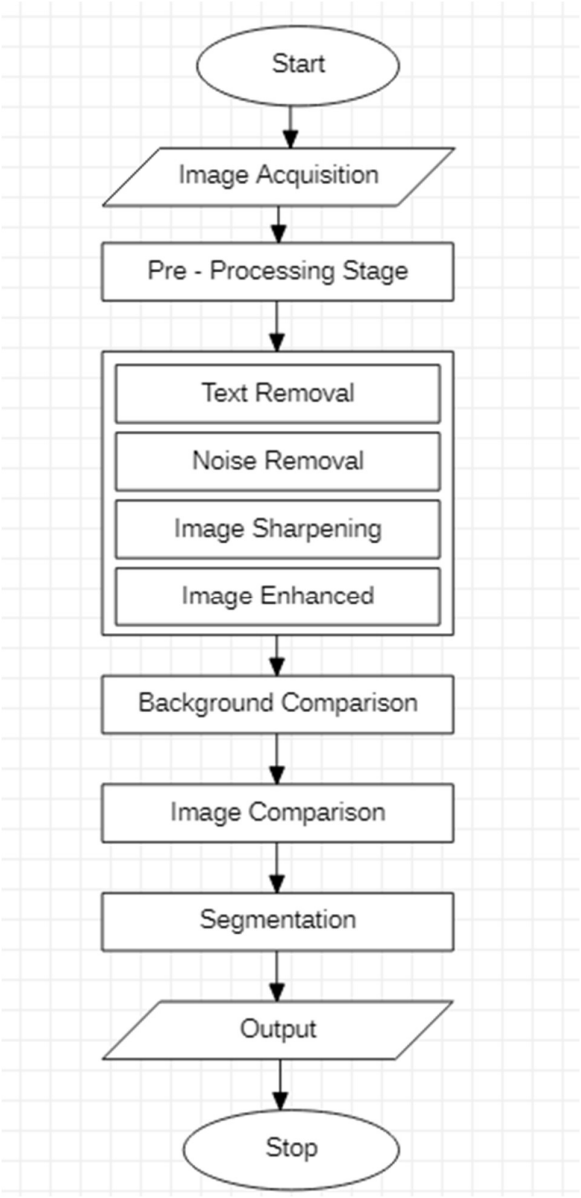


Figure 4.3: Flow Chart Diagram

CHAPTER 5
SYSTEM MODELLING

5. SYSTEM MODELLING

5.1 Testing

Is it possible to invoke each menu function using logical assumptions that if all parts of the system are correct, the goal will be successfully achieved? In adequate testing or non-testing will leads to errors that may appear few months later. That's why it is very important to always test the new software. This creates two problems.

The purpose of the system testing is to consider all the likely variations to which it will be suggested and push the systems to limits.

The testing process focuses on the logical intervals of the software ensuring that all statements have been tested and on functional interval is conducting tests to uncover errors and ensure that defined input will produce actual results that agree with the required results. Program level testing, modules level testing integrated and carried out. There are two major type of testing they are

1. White Box Testing
2. Black Box Testing

White Box Testing White box sometimes called "Glass box testing" is a test case design that uses the control structure of the procedural design to drive test case.

Using white box testing methods, the following tests were made on the system:

- Design all test scenarios, test cases and prioritize them according to high priority number.
- This step involves the study of code at runtime to examine the resource utilization, not accessed areas of the code, time taken by various methods and operations and so on.
- Here interfaces are able to handle all types of data appropriately or not is checked.
- This step focuses on testing of control statements like loops and conditional statements to check the efficiency and accuracy for different data inputs.
- In the last step white box testing includes security testing to check all possible security loopholes by looking at how the code handles security.

Black box testing is not an alternative to white box testing rather it is complementary approach that is likely to uncover a different class of errors that white box methods like.

1. Interface errors
2. Performance in data structure
3. Performance errors
4. Initializing and termination errors

Black-box testing of machine learning (ML) models refers to testingwith no knowledge about the internal details of the model, such asthe algorithm used to create it and the features in it. The mainobjective of black-box testing is to ensure the quality of the modelsin a sustained manner.

ML models, however, are often considered untestable because ofthe difficulty in performing black-box testing on them. Since MLmodels output some sort of prediction, there are no expectedvalues against which to verify test outcomes.

CHAPTER 6

CONCLUSION & FUTURE WORK

6. CONCLUSION & FUTURE WORK

In this study, using MR images of the brain, we segmented brain tissues into normal tissues such as white matter, gray matter, cerebrospinal fluid (background), and tumor-infected tissues. Fifteen patients infected with a glial tumor, in benign and malignant stages, assisted in this study. We used preprocessing to improve the signal-to-noise ratio and to eliminate the effect of unwanted noise. We used a skull stripping algorithm based on threshold technique to improve the skull stripping performance. Furthermore, we used Berkeley wavelet transform to segment the images and support vector machine to classify the tumor stage by analyzing feature vectors and area of the tumor. In this study, we investigated texture based and histogram based features with a commonly recognized classifier for the classification of brain tumor from MR brain images. From the experimental results performed on the different images, it is clear that the analysis for the brain tumor detection is fast and accurate when compared with the manual detection performed by radiologists or clinical experts. The various performance factors also indicate that the proposed algorithm provides better result by improving certain parameters such as mean, MSE, PSNR, accuracy, sensitivity, specificity, and dice coefficient. Our experimental results show that the proposed approach can aid in the accurate and timely detection of brain tumor along with the identification of its exact location. Thus, the proposed approach is significant for brain tumor detection from MR images.

The experimental results achieved 96.51% accuracy demonstrating the effectiveness of the proposed technique for identifying normal and abnormal tissues from MR images. Our results lead to the conclusion that the proposed method is suitable for integrating clinical decision support systems for primary screening and diagnosis by the radiologists or clinical experts.

In the future work, to improve the accuracy of the classification of the present work, we are planning to investigate the selective scheme of the classifier by combining more than one classifier and feature selection techniques.

6.1 Limitations of Project

I. Since the main components of our entire system are our machine learning models, which are trained to predict results on the basis of their training. Now prediction is the word that need to be empathize here, the model will only PREDICT the results, it does not know the truth.

We've trained our model enough to predict with an accuracy of around 80%. It can be improved with a good quality dataset, but as of now, if the accuracy doesn't match the reality, its not the system's fault.

II. As of now, we are only predicting 3 different types of tumors due to lack of datasets, if your MRI includes any other, our system might fail to give appropriate result.

6.2 Future Enhancement

There's a lot to do in future:

I. Improving the accuracy rate: As more and more user will upload MRI images, we'll not only predict them, but we'll add them to our training dataset. More number of data to learn from, more accurate the model will predict.

II. We'll try to upgrade the model to predict all types of brain tumors not only that, is predicted tumor cancerous or not can also be predicted.

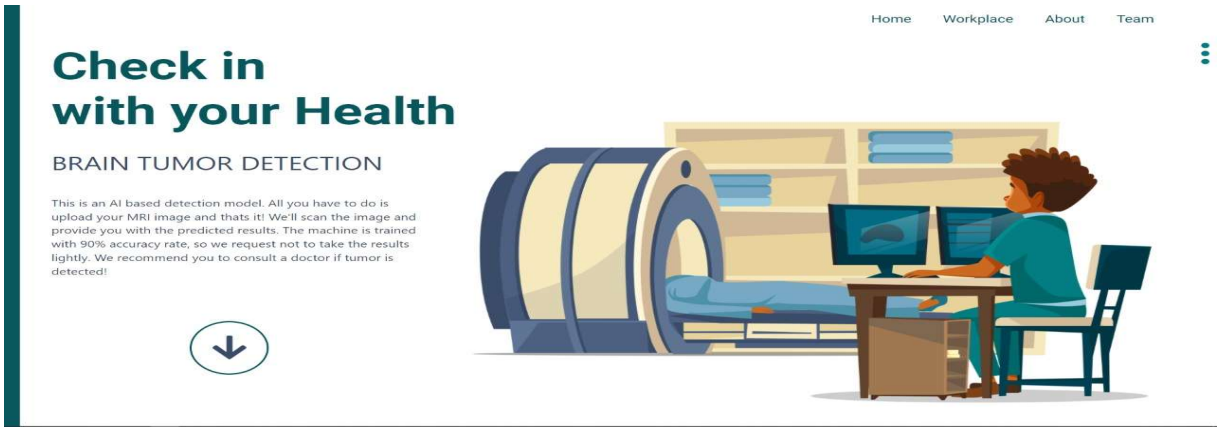
III. If all the prediction with brain tumor goes well, we can also upgrade the system from Brain Tumor Detection to All Sort of Tumor Detection, but it'll require a lot amount of dataset and storage space.

CHAPTER 7

IMPLEMENTATION

7.1 Snapshot

Home Page



Work Place

The area where user is supposed to upload the MRI image and detect the presence of tumor, this component is connected to the ML models, where the image uploaded enters the validation model which checks whether the images is MRI or not and is then sent to the next model in which detects the presence of Brain Tumor.

About

A brief about Brain Tumor, its symptoms, treatment, and its prevention.

A BRIEF ABOUT BRAIN TUMOR

A brain tumor is a collection, or mass, of abnormal cells in your brain. Your skull, which encloses your brain, is very rigid. Any growth inside such a restricted space can cause problems. Brain tumors can be cancerous (malignant) or noncancerous (benign). When benign or malignant tumors grow, they can cause the pressure inside your skull to increase. This can cause brain damage, and it can be life-threatening.

Brain tumors are categorized as primary or secondary. A primary brain tumor originates in your brain. Many primary brain tumors are benign. A secondary brain tumor, also known as a metastatic brain tumor, occurs when cancer cells spread to your brain from another organ, such as your lung or breast.

What are the symptoms of a brain tumor?

Symptoms of brain tumors depend on the location and size of the tumor. Some tumors cause direct damage by invading brain tissue and some tumors cause pressure on the surrounding brain. You'll have noticeable symptoms when a growing tumor is putting pressure on your brain tissue.

Headaches are a common symptom of a brain tumor. You may experience headaches that:

- are worse in the morning when waking up
- occur while you're sleeping
- are made worse by coughing, sneezing, or exercise

You may also experience:

- vomiting
- blurred vision or double vision
- confusion
- seizures (especially in adults)
- weakness of a limb or part of the face
- a change in mental functioning

Treatment of brain tumors

The treatment of a brain tumor depends on:

- the type of tumor
- the size of the tumor
- the location of the tumor
- your general health

The most common treatment for malignant brain tumors is surgery. The goal is to remove as much of the cancer as possible without causing damage to the healthy parts of the brain. While the location of some tumors allows for easy and safe removal, other tumors may be located in an area that limits how much of the tumor can be removed. Even partial removal of brain cancer can be beneficial.

Risks of brain surgery include infection and bleeding. Clinically dangerous benign tumors are also surgically removed. Metastatic brain tumors are treated according to guidelines for the type of original cancer.

Surgery can be combined with other treatments, such as radiation therapy and chemotherapy. Physical therapy, occupational therapy, and speech therapy can help you to recover after neurosurgery.

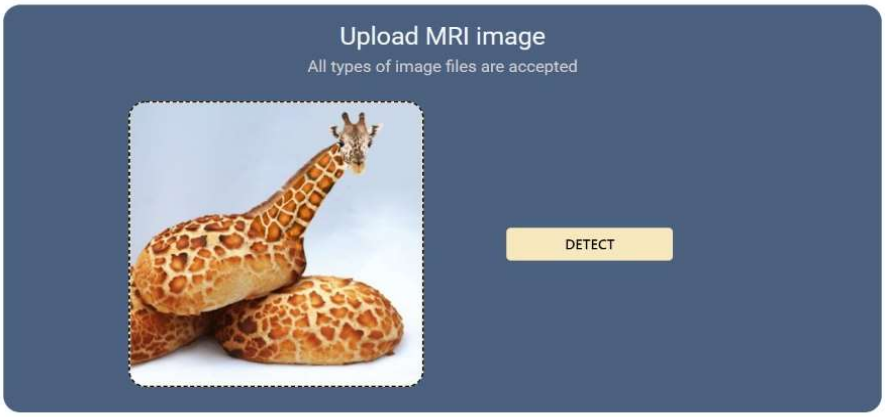
Can tumors be prevented?

Genetics plays a role, so you can't prevent all tumors. Still, there are steps you can take to lower your risk for developing cancerous tumors:

- Don't use tobacco, and avoid exposure to secondhand smoke.
- Limit your alcohol consumption to not more than one drink per day for women, two drinks per day for men.
- Maintain a healthy weight.
- Include plenty of fruits, vegetables, whole grains, and beans in your diet while limiting processed meats.
- Exercise regularly.
- Protect your skin from the sun.
- Get regular medical checkups and screenings, and report any new symptoms.

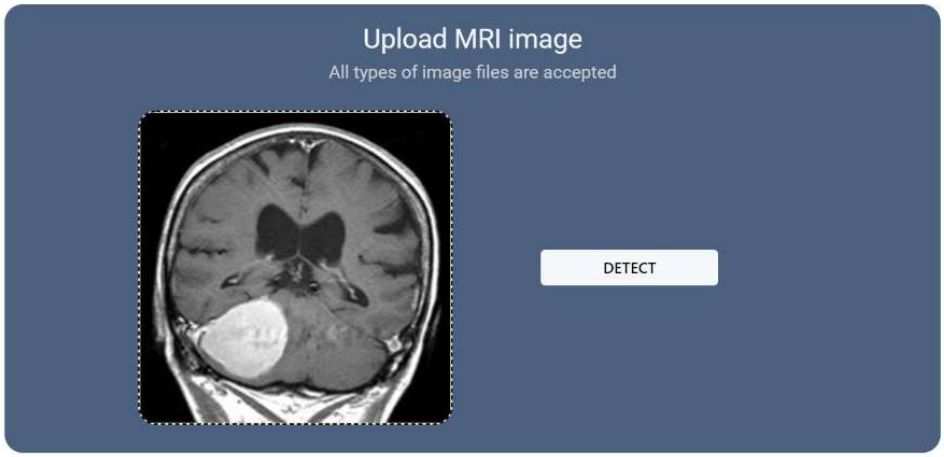
The Team

Invalid Input



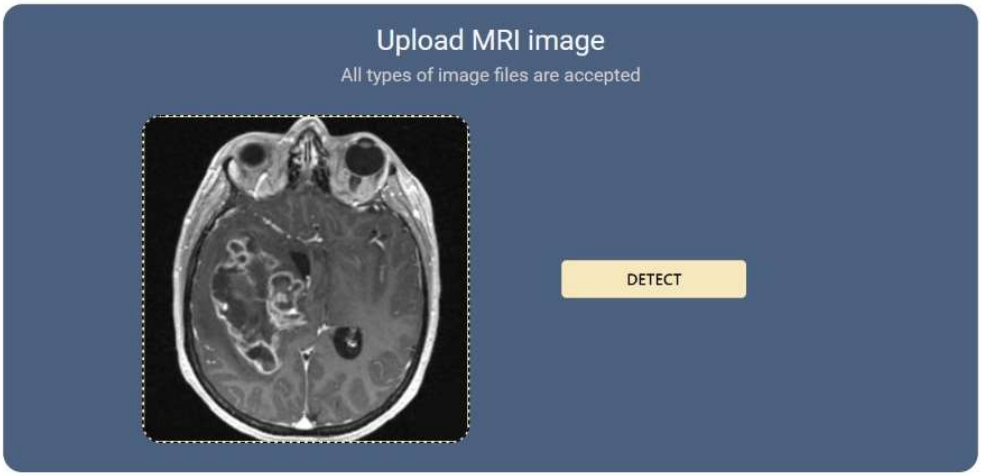
Output: **INVALID IMAGE,** Looks like the image does not fulfil the requirements, please upload a valid MRI image!

No Tumor Detected



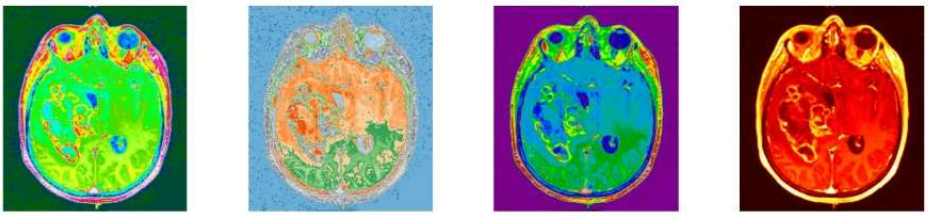
Output: **NO TUMOR DETECTED,** Everything looks fine, stay safe :).

Tumor Detected (Meningioma Tumor)



TUMOR DETECTED: 'Meningioma Tumor' detected, we suggest you to keep calm and consult the doctor as soon as possible :)

Here are few varients of HEAT MAP of the MRI you uploaded:

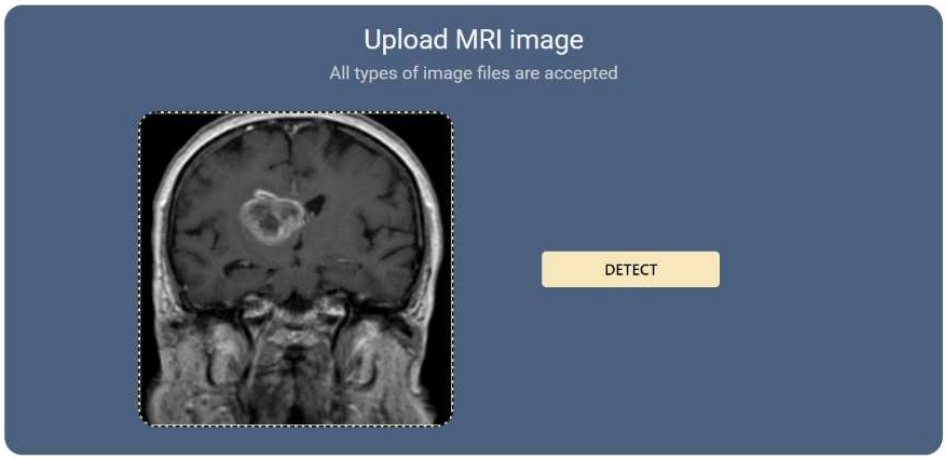


Here is the list of few doctors, who can surely help you out with this!

S.NO.	NAME	CONTACT	LOCATION
1	Dr. Atul Prasad	Click here	Delhi
2	Dr. Rana Patir	Click here	Delhi
3	Dr. Rajiv Anand	Click here	Delhi
4	Dr. Sandeep Vaishya	Click here	Gurgaon
5	Dr. Chandran Gnanamuthu	Click here	Bangalore
6	Dr.V.Murugan	Click here	Chennai

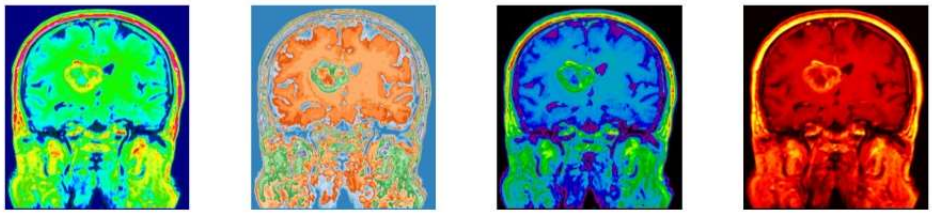
Output: TUMOR DETECTED, '**Meningioma Tumor**' detected, we suggest you to keep calm and consult the doctor as soon as possible.

Tumor Detected (Pituitary Tumor)



TUMOR DETECTED: 'Pituitary Tumor' detected, we suggest you to keep calm and consult the doctor as soon as possible :)

Here are few varients of HEAT MAP of the MRI you uploaded:

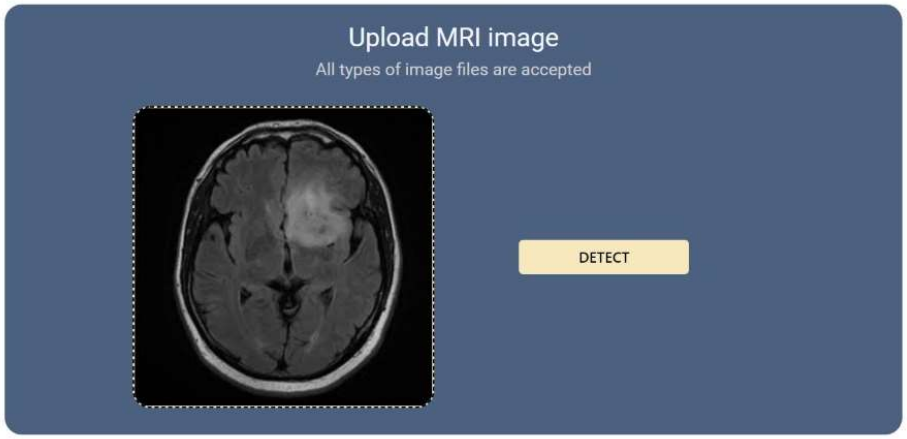


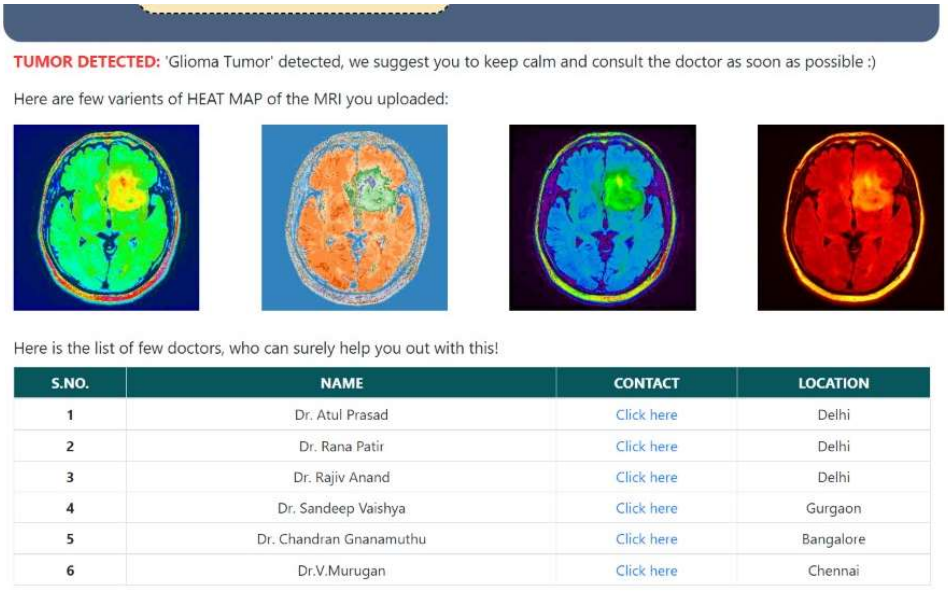
Here is the list of few doctors, who can surely help you out with this!

S.NO.	NAME	CONTACT	LOCATION
1	Dr. Atul Prasad	Click here	Delhi
2	Dr. Rana Patir	Click here	Delhi
3	Dr. Rajiv Anand	Click here	Delhi
4	Dr. Sandeep Vaishya	Click here	Gurgaon
5	Dr. Chandran Gnanamuthu	Click here	Bangalore
6	Dr.V.Murugan	Click here	Chennai

Output: TUMOR DETECTED, '**Pituitary Tumor**' detected, we suggest you to keep calm and consult the doctor as soon as possible.

Tumor Detected (Glioma Tumor)





S.NO.	NAME	CONTACT	LOCATION
1	Dr. Atul Prasad	Click here	Delhi
2	Dr. Rana Patir	Click here	Delhi
3	Dr. Rajiv Anand	Click here	Delhi
4	Dr. Sandeep Vaishya	Click here	Gurgaon
5	Dr. Chandran Gnanamuthu	Click here	Bangalore
6	Dr.V.Murugan	Click here	Chennai

Output: TUMOR DETECTED, '**Glioma Tumor**' detected, we suggest you to keep calm and consult the doctor as soon as possible.

CHAPTER 8

BIBLIOGRAPHY & REFERENCES

8. BIBLIOGRAPHY & REFERENCES

8.1 Reference Books

- S.U. Aswathy, G.Glan Deva Dhas and S.S. Kumar ―"A Survey on detection of brain tumor from MRI Brain images", 7th International Conference on Cloud Computing, Data Science & Engineering –Confluence 2017.
- S. Banerjee, S. Mitra, and B. U. Shankar, ―"Synergetic neuro-fuzzy feature selection and classification of brain tumors," in 2017 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE), 2017, pp.1–6.
- S. Bakas, M. Reyes, A. Jakab, S. Bauer, M. Rempfler, A. Crimi, et al., "Identifying the Best Machine Learning Algorithms for Brain Tumor Segmentation, Progression Assessment, and Overall Survival Prediction in the BRATS Challenge", arXiv preprint arXiv:1811.02629 (2018)
- S. Bakas, H. Akbari, A. Sotiras, M. Bilello, M. Rozycki, J.S. Kirby, et al., "Advancing The Cancer Genome Atlas glioma MRI collections with expert segmentation labels and radiomic features", Nature Scientific Data, 4:170117 (2017) DOI: 10.1038/sdata.2017.117
- B. H. Menze, A. Jakab, S. Bauer, J. Kalpathy-Cramer, K. Farahani, J. Kirby, et al. "The Multimodal Brain Tumor Image Segmentation Benchmark (BRATS)", IEEE Transactions on Medical Imaging 34(10), 1993-2024 (2015) DOI: 10.1109/TMI.2014.2377694
- S.C. Turaga, J.F. Murray, V. Jain, F. Roth, M. Helmstaedter, K. Briggman,W. Denk, and H.S. Seung. Convolutional networks can learn to generate affinity graphs for image segmentation. Neural Computation, 22(2):511–538, 2010
- RaselAhmmed, Md. Foisal Hossain ―Tumor Detection in Brain MRI Image Using Template based K-means and Fuzzy C-means Clustering Algorithm‖ 2016 International Conference on Computer Communication and Informatics (ICCCI -2016), Jan. 07 –09, 2016, Coimbatore, INDIA
- Vinod Kumar, JainySachdeva, Indra Gupta ―Classification of brain tumors using PCA-ANN‖ 2011 World Congress on Information and Communication Technologies

8.2 Other Documentation & Resources

8.2.1 Other Reference Sites

- https://www.google.com/
- https://en.wikipedia.org/
- https://www.stackoverflow.com/
- https://youtube.com/
- https://github.com

8.2.2 Other Documentation

Presentation 1:

https://drive.google.com/file/d/1HYalAZLond1P-_H2EzNr7zbgFK5E1a2b/view?usp=sharing

Presentation 2:

https://drive.google.com/file/d/12J8wVSH5LtFJf842lSf4AjN3t9_YOSjj/view?usp=sharing

Presentation 3:

https://drive.google.com/file/d/1tMAC6UdXVKamqOrvUIkZGhBFi6nFvn8G/view?usp=sharing