

# Brain Tumor Detection Using Deep Learning

By

*18CP813: Parmar Ankita*

*Guided by*

*Dr. Mehfuza Holia*

*Prof. Pranay Patel*

A Dissertation Submitted to  
Birla Vishvakarma Mahavidyalaya (Engineering College), An Autonomous Institution affiliated  
to Gujarat Technological University in Partial Fulfillment of the Requirements for  
the Master of Technology (*Computer Engineering*) with Specialization in *Software Engineering*

*July 2020*



**BIRLA VISHVAKARMA MAHAVIDYALAYA**  
**(ENGINEERING COLLEGE)**  
**AN AUTONOMOUS INSTITUTION**  
**Vallabh Vidyanagar – 388120**  
**GUJARAT, INDIA**

## **COMPLIANCE CERTIFICATE**

This is to certify that the research work embodied in this dissertation entitled “***Brain tumor Detection Using Deep Learning***” was carried out by **18CP813: Parmar Ankita**, at Birla Vishvakarma Mahavidyalaya (Engineering College) An Autonomous Institution for partial fulfillment of Master of Technology (***Computer Engineering***) with Specialization in ***Software Engineering*** degree to be awarded by Gujarat Technological University. He / She has complied to the comments given by the Dissertation phase – I as well as Mid Semester Dissertation Reviewer to my / our satisfaction.

Date :

Place :

---

(***Parmar Ankita***)

---

(***Dr. Mehfuza Holia***)

---

(***Prof. Pranay Patel***)

---

Head, (***Computer Department***)  
(***Dr. D. G. Thakore***)

---

Principal  
(***Dr. I. N. Patel***)



**BIRLA VISHVAKARMA MAHAVIDYALAYA**  
**(ENGINEERING COLLEGE)**  
**AN AUTONOMOUS INSTITUTION**  
**Vallabh Vidyanagar – 388120**  
**GUJARAT, INDIA**

## **PAPER PUBLICATION CERTIFICATE**

This is to certify that the research work embodied in this dissertation entitled “***Brain Tumor Detection Using Deep Learning***” was carried out by **18CP813: Parmar Ankita** at Birla Vishvakarma Mahavidyalaya (Engineering College) An Autonomous Institution for partial fulfillment of Master of Technology (***Computer Engineering***) with Specialization in ***Software Engineering*** degree to be awarded by Gujarat Technological University. He / She has published/article entitled ***Brain Tumor Detection Using Deep Learning: A Survey*** accepted for publication by the ***International Journal of Advance Engineering and Research Development*** at ***Vallabh Vidyanagar, Anand, Gujarat, India*** during/on **04, April 2020**.

Date :

Place :

---

(***Parmar Ankita***)

---

(***Dr. Mehfuza Holia***)

---

(***Prof. Pranay Patel***)

---

**Head, (Computer Department)**  
(***Dr. D. G. Thakore***)

---

**Principal**  
(***Dr. I. N. Patel***)



**BIRLA VISHVAKARMA MAHAVIDYALAYA**  
**(ENGINEERING COLLEGE)**  
**AN AUTONOMOUS INSTITUTION**  
**Vallabh Vidyanagar – 388120**  
**GUJARAT, INDIA**

## **DECLARATION OF ORIGINALITY**

I hereby certify that I am the sole author of this dissertation and that neither any part of this dissertation nor the whole of the dissertation has been submitted for a degree to any other University or Institution.

I certify that, to the best of my knowledge, my dissertation does not infringe upon anyone's copyright nor violate any proprietary rights and that any ideas, techniques, quotations or any other material from the work of other people included in my dissertation, published or otherwise, are fully acknowledged in accordance with the standard referencing practices. Furthermore, to the extent that I have included copyrighted material that surpasses the bounds of fair dealing within the meaning of the Indian Copyright Act, I certify that I have obtained a written permission from the copyright owner(s) to include such material(s) in my dissertation and have included copies of such copyright clearances to our appendix.

I declare that this is a true copy of dissertation, including any final revisions, as approved by my dissertation review committee.

**Date:**

---

(18CP813: Parmar Ankita)



**BIRLA VISHVAKARMA MAHAVIDYALAYA**  
**(ENGINEERING COLLEGE)**  
**AN AUTONOMOUS INSTITUTION**  
**Vallabh Vidyanagar – 388120**  
**GUJARAT, INDIA**

## CERTIFICATE

This is to certify that work embodied in this dissertation entitled “**Brain Tumor Detection Using Deep Learning** “ was carried out by **18CP813:Parmar Ankita**, at Birla Vishvakarma Mahavidyalaya (Engineering College) An Autonomous Institution for partial fulfillment of Master of Technology (**Computer Engineering**) with Specialization in **Software Engineering** degree to be awarded by Gujarat Technological University. This work has been carried out under my / our supervision meets the requirement of Gujarat Technological University.

Date :

Place :

---

(*Dr. Mehfuza Holia*)

---

(*Prof. Pranay Patel*)

---

Head, (*Computer Department*)  
(*Dr. D. G. Thakore*)

---

Principal  
(*Dr. I. N. Patel*)



**BIRLA VISHVAKARMA MAHAVIDYALAYA**  
**(ENGINEERING COLLEGE)**  
**AN AUTONOMOUS INSTITUTION**  
**Vallabh Vidyanagar – 388120**  
**GUJARAT, INDIA**

## **DISSERTATION APPROVAL CERTIFICATE**

This is to certify that dissertation titled “*Brain Tumor Detection Using Deep Learning*” was carried out by **18CP813: Parmar Ankita** at Birla Vishvakarma Mahavidyalaya (Engineering College) An Autonomous Institution is approved for award of the degree of Master of Technology (*Computer Engineering*) with Specialization in *Software Engineering* by Gujarat Technological University.

Date :

Place :

<b>Signature:</b>			
<b>Name:</b>			

Examiners



**BIRLA VISHVAKARMA MAHAVIDYALAYA**  
**(ENGINEERING COLLEGE)**  
**AN AUTONOMOUS INSTITUTION**  
**Vallabh Vidyanagar – 388120**  
**GUJARAT, INDIA**

## **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.

## **ACKNOWLEDGMENTS**

This thesis is based on research work conducted for "Brain Tumor Detection using deep learning techniques". This work would not be possible without two people whose contributions can't be ignored.

I consider it an honor to work under my guides Dr. Mehfuza Holia and Prof .Pranay Patel. This thesis is on brain tumor detection. They were always available to monitor me for this work. I specially acknowledge Dr. Mehfuza Holia for guide me in brain tumor detection research work and always support me. And thanks to prof. Pranay Patel for always solve the coding problem in my dissertation work.

I am grateful to Birla Vishvakarma Mahavidyalaya College of Engineering for providing everything from faculty guides to resources for this work. I would like to thank all other people who have directly or indirectly helped me to realize this work.



## TABLE OF CONTENTS

<b>Sr.No.</b>	<b>Topic</b>	<b>Pageno.</b>
	Abstract.....	I
	Acknowledgments.....	II
	Table of Contents.....	III
	List of Figures.....	IV
	List of tables.....	V
<b>1.</b>	<b>Introduction.....</b>	<b>1</b>
	1.1 Brain Tumor Detection system.....	1
	1.2 Application .....	4
	1.3 Objectives.....	4
	1.4 Motivation.....	5
	1.5 Organization of Report.....	5
<b>2.</b>	<b>Literature Survey.....</b>	<b>6</b>
<b>3.</b>	<b>Existing work &amp; proposed workflow.....</b>	<b>8</b>
	3.1 Overview of Existing work.....	8
	3.2 Proposed workflow.....	12
<b>4.</b>	<b>Dataset, Implementation and Results.....</b>	<b>16</b>
	4.1 Dataset Details.....	16
	4.2 Tools & Technology used.....	16
	4.3 Results.....	18
<b>5.</b>	<b>Conclusion .....</b>	<b>23</b>
	5.1 Conclusion.....	23
	<b>References.....</b>	<b>24</b>
	<b>APPENDIX A .....</b>	<b>26</b>
	<b>APPENDIX B .....</b>	<b>27</b>
	<b>APPENDIX C .....</b>	<b>28</b>
	<b>APPENDIX D .....</b>	<b>29</b>

## LIST OF FIGURES

<b>Sr no</b>	<b>Figure</b>	<b>Page no</b>
1	Basic Structure of human brain	2
2	T1, T2 and Flair image	3
3	Graph of TE and TR	3
4	Table of TR and TE time	4
5	Existing work flow of brain tumor detection.	8
6	Steps used in skull stripping algorithm	10
7	Proposed work flow of brain tumor detection	12
8	Working of CNN model for brain tumor detection	13
9	VGG16 layered architecture	14
10	Working of VGG16 model for brain tumor detection	14
11	Label of the image	18
12	Split the image data	18
13	Train CNN image data	18
14	Test CNN image data	19
15	Train VGG16 image data	19
16	Train VGG16 image data	19
17	Chart of CNN vs. VGG16	22

## LIST OF TABLES

<b>Sr. no</b>	<b>Figure</b>	<b>Page no.</b>
1	CNN model summary table	20
2	Transfer learning VGG16 model summary	21
3	Chart of CNN vs. VGG16	21

# 1. INTRODUCTION

## 1.1 BRAIN TUMOR DETECTION SYSTEM

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 [4].

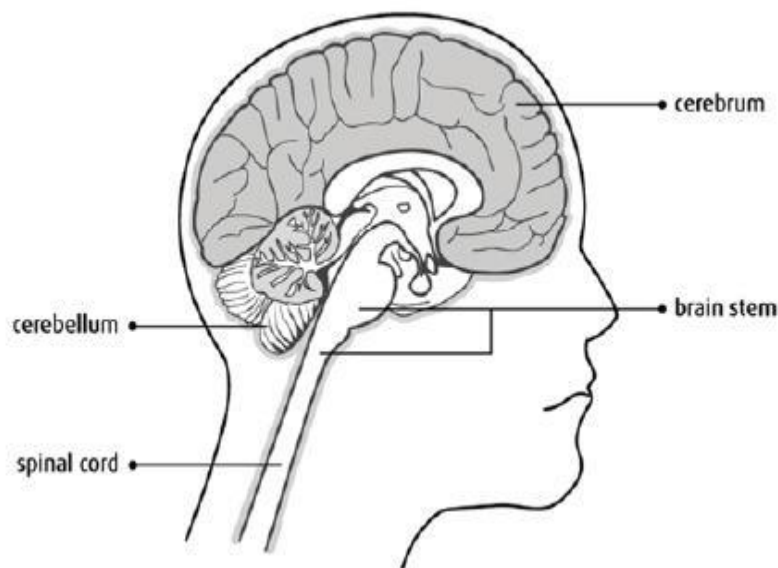


Fig.1: Basic Structure of human brain [5]

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 [6]. 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 lungs cancer, kidney cancer, bladder cancer etc [7].

### 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.

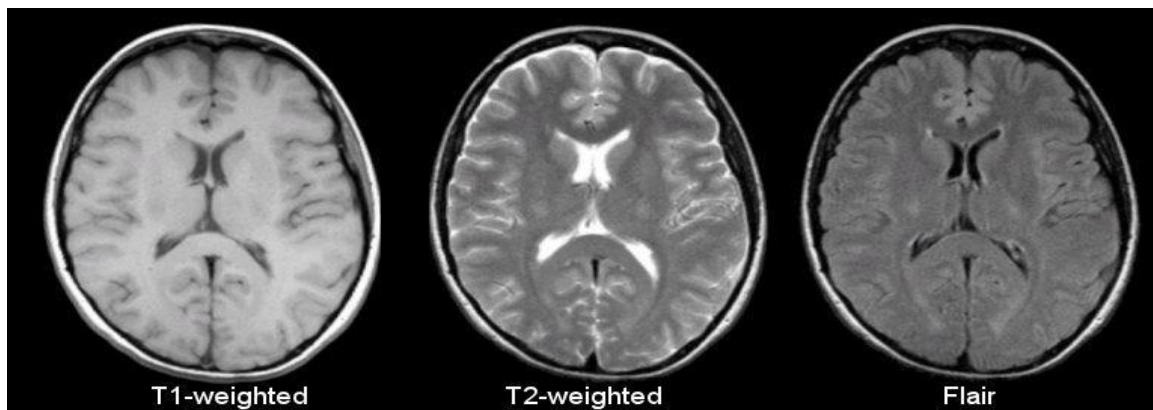


Fig 2: T1, T2 and Flair image [9]

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 and 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.

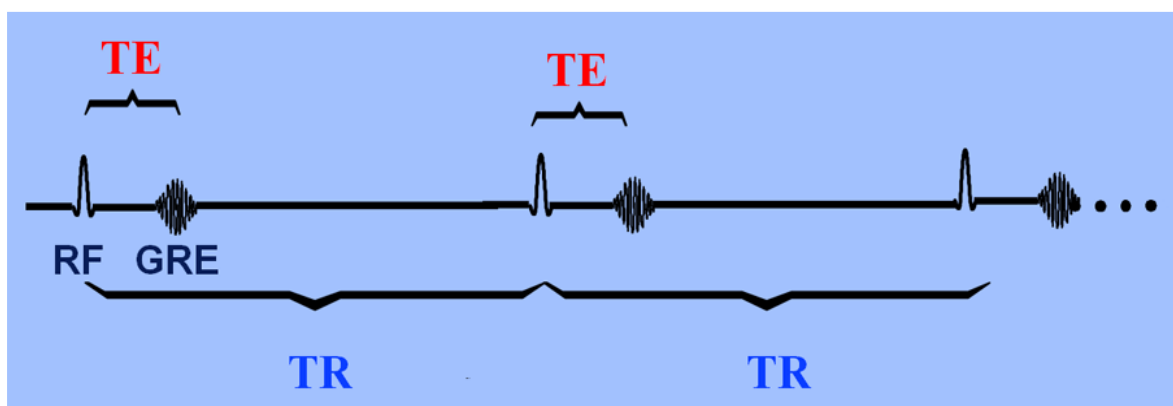


Fig. 3: Graph of TE and TR [10]

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.

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

Fig.4: Table of TR and TE time [9]

## 1.2 APPLICATION

- The main aim of the applications is tumor identification.
- The main reason behind the development of this application is to provide proper treatment as soon as possible and protect the human life which is in danger.
- This application is helpful to doctors as well as patient.
- The manual identification is not so fast, more accurate and efficient for user. To overcome those problem this application is design.
- It is user friendly application.

## 1.3 OBJECTIVE

- To provide doctors good software to identify tumor and their causes.
- Save patient's time.
- Provide a solution appropriately at early stages.
- Get timely consultation.

## **1.4 MOTIVATION**

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.

## **1.5 ORGANIZATION OF REPORT**

Chapter 1 gives the brief introduction of Brain tumor Detection and Classification using Deep Learning, its applications, objective of the system and motivation.

Chapter 2 contains literature survey that provide summary of individual paper.

Chapter 3 provides overview of existing work for Brain tumor detection and classification that has been done using done using CNN.

Chapter 4 presents Implementation and its results, tools and technology used to achieve this and dataset detail.

Chapter 5 contains conclusion about Brain tumor detection using deep learning.



## 2. LITERATURE SURVEY

### **Paper-1: Image Analysis for MRI Based Brain Tumor Detection and Feature Extraction Using Biologically Inspired BWT and SVM**

- **Publication Year:** 6 March 2017
- **Author:** Nilesh Bhaskarrao Bahadure, Arun Kumar Ray, and Har Pal Thethi
- **Journal Name:** Hindawi International Journal of Biomedical Imaging
- **Summary:** In this paper 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. We used pre-processing to improve the signal-to-noise ratio and to eliminate the effect of unwanted noise. We can use the skull stripping algorithm its based on threshold technique for improve the skull stripping performance.

### **Paper-2: A Survey on Brain Tumor Detection Using Image Processing Techniques**

- **Publication Year:** 2017
- **Author:** Luxit Kapoor, Sanjeev Thakur
- **Journal Name:** IEEE 7th International Conference on Cloud Computing, Data Science & Engineering
- **Summary:** This paper surveys the various techniques that are part of Medical Image Processing and are prominently used in discovering brain tumors from MRI Images. Based on that research this Paper was written listing the various techniques in use. A brief description of each technique is also provided. Also of All the various steps involved in the process of detecting Tumors, Segmentation is the most significant.

**Paper-3: Identification of Brain Tumor using Image Processing Techniques**

- **Publication Year:** 11 September 2017
- **Author:** Praveen Gamage
- **Journal Name:** Research gate
- **Summary:** This paper survey of Identifying brain tumors through MRI images can be categorized into four different sections; pre-processing, image segmentation, Feature extraction and image classification.

**Paper-4: Review of Brain Tumor Detection from MRI Images**

- **Publication Year:** 2016
- **Author:** Deepa, Akansha Singh
- **Journal Name:** IEEE International Conference on Computing for Sustainable Global Development
- **Summary:** In this paper, some of the recent research work done on the Brain tumor detection and segmentation is reviewed. Different Techniques used by various researchers to detect the brain Tumor from the MRI images are described. By this review we found that automation of brain tumor detection and Segmentation from the MRI images is one of the most active Research areas.

**Paper-5: An efficient Brain Tumor Detection from MRI Images using Entropy Measures**

- **Publication Year:** December 23-25, 2016
- **Author:** Devendra Somwanshi , Ashutosh Kumar, Pratima Sharma, Deepika Joshi
- **Journal Name:** IEEE International Conference on Recent Advances and Innovations in Engineering
- **Summary:** In this paper, we have investigated the different Entropy functions for tumor segmentation and its detection from various MRI images. The different threshold values are obtained depend on the particular definition of the entropy. The threshold values are dependent on the different entropy function which in turn affects the segmented results.

### 3. EXITING WORK & PROPOSED WORKFLOW

#### 3.1 OVERVIEW OF EXITING WORK

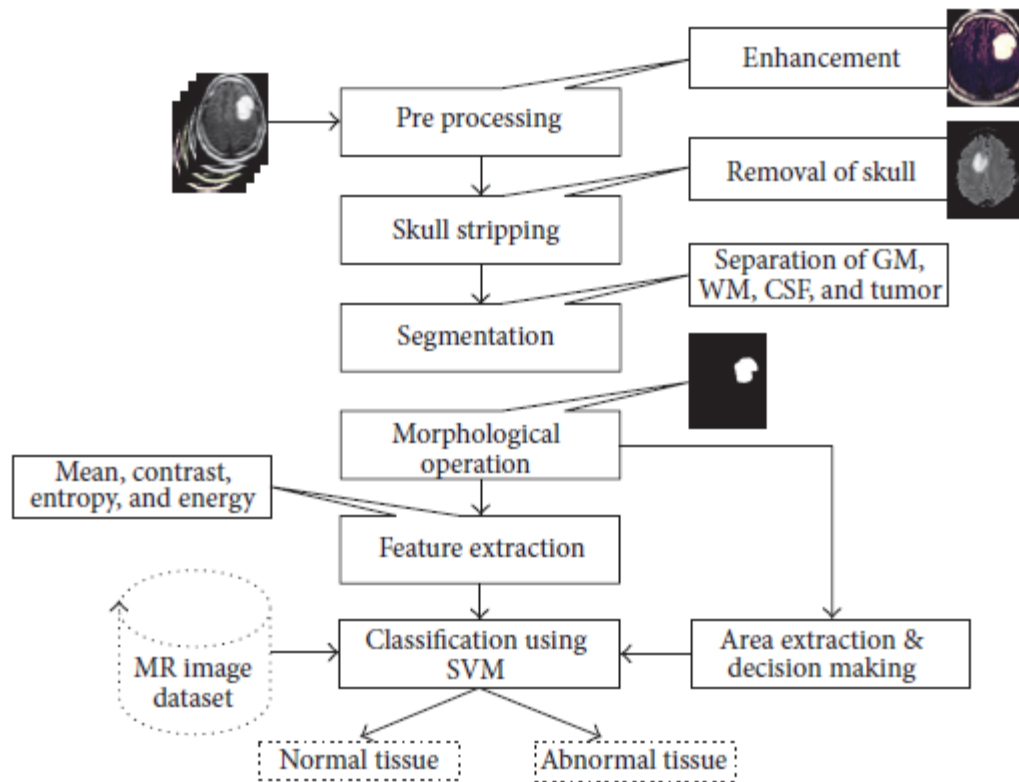


Fig.5.Existing work flow of brain tumor detection. [12]

- In the first stage, there is a computer based procedures to detect tumor blocks and classify the type of tumor using Artificial Neural Network Algorithm for MRI images of different patients.
- The second stage involves the use of different image processing techniques such as histogram equalization, image segmentation, image enhancement, morphological operations and feature extraction are used for brain tumor detection in the MRI images for the cancer-affected patients.
- This work iss introduced one automatic brain tumor detection method to increase the accuracy and decrease the diagnosis time.

- **Image Preprocessing:** As input for this system is MRI, scanned image and it contain noise. Therefore, our first aim is to remove noise from input image. As explained in system flow we are using high pass filter for noise removal and preprocessing.
- **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.
- **Morphological operation:** The morphological operation is used for the extraction of boundary areas of the brain images. This operation is only rearranging the relative order of pixel value, not mathematical value, so it is suitable for only binary images. Dilation and erosion is basic operation of morphology. Dilation is add pixels to the boundary region of the object, while erosion is remove the pixels from the boundary region of the objects.
- **Feature Extraction:** The feature extraction is used for edge detection of the images. It is the process of collecting higher level information of image such as shape, texture, color, and contrast.
- **Connected component labeling:** After recognizing connected components of an image, every set of connected pixels having same gray-level values are assigned the same unique region label.
- **Tumor Identification:** In this phase, we are having dataset previously collected brain MRIs from which we are extracting features. Knowledge base is created for comparison.

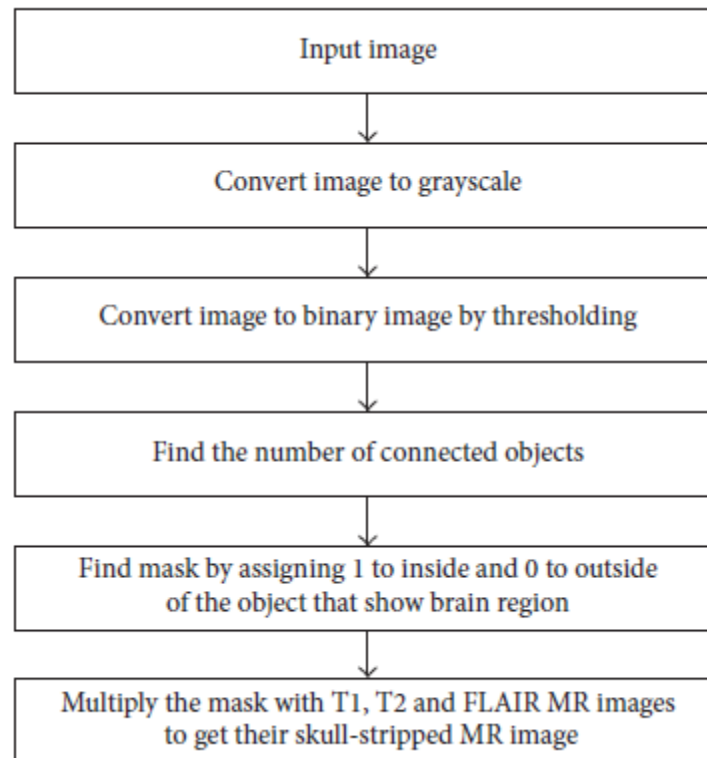


Fig. 6.Steps used in skull stripping algorithm.[12]

- In the first step we can take image as input. In the image we used tumor in the image and only fat and water tissues in the images.
- In the second step convert image to grayscale
  - Signal to noise
  - Complexity of the code
  - Learning image processing
  - Difficulty of visualization
  - Color is complex
- Then we convert image to binary image by thresholding.

Thresholding is the simplest method of image segmentation and the most common way to convert a grayscale image to binary image.

In thresholding we select threshold value and then gray level value .below the selected threshold value is classified as 0.and equal and greater then the threshold value are classified as 1.
- Find the number of connected object

- Find mask by assigning 1 to inside and 0 to outside of the object that show brain region.
- Multiply the mask with T1,T2 and FLAIR MR images to get their skull stripped MR image
  - T1 & T2: weighted MRI
  - FLAIR: fluid attenuated inversion recovery weighted MRI.

Types of MRI images

- T1: one tissue type is bright-FAT
- T2: two tissue types are bright-FAT and water

### 3.2 PROPOSED WORKFLOW

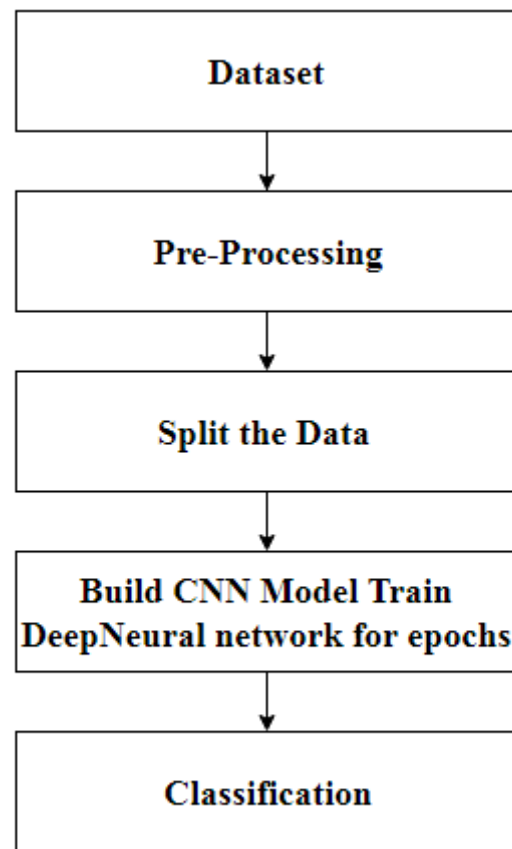


Fig. 7. Proposed work flow of brain tumor detection

The proposed system has mainly five modules. Dataset, Pre-processing, Split the data, Build CNN model train Deep Neural network for epochs, and classification. In dataset we can take multiple MRI images and take one as input image. In pre-processing image to encoded the label and resize the image. In split the data we set the image as 80% Training Data and 20% Testing Data. Then build CNN model train deep neural network for epochs. Then classified the image as yes or no if tumor is positive then it returns yes and the tumor is negative the it returns no.

### 3.2.1 Working of CNN model

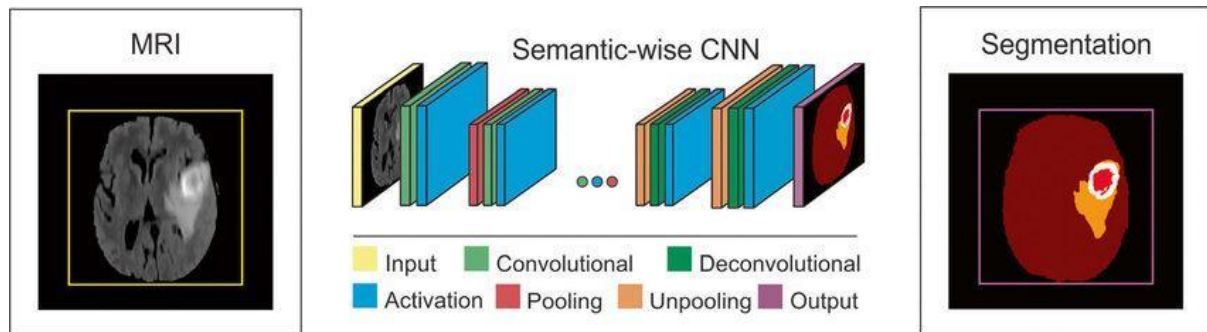


Fig.8.Working of CNN model for brain tumor detection [14]

➤ **Layer of CNN model:**

- Convolution 2D
- MAX Poolig2D
- Dropout
- Flatten
- Dense
- Activation

- **Convolution 2D:** In the Convolution 2D extract the featured from input image. It given the output in matrix form.
- **MAX Poolig2D:** In the MAX polling 2D it take the largest element from rectified feature map.
- **Dropout:** Dropout is randomly selected neurons are ignored during training.
- **Flatten:** Flatten feed output into fully connected layer. It gives data in list form.
- **Dense:** A Linear operation in which every input is connected to every output by weight. It followed by nonlinear activation function.
- **Activation:** It used Sigmoid function and predict the probability 0 and 1.
- In the compile model we used binary cross entropy because we have two layers 0 and 1.
- We used Adam optimizer in compile model.

Adam:-Adaptive moment estimation. It used for non convex optimization problem like straight forward to implement.

- Computationally efficient.
- Little memory requirement.



### 3.2.2 Working of VGG16 model

Transfer learning is a knowledge- sharing method that reduces the size of the training data, the time and the computational costs when building deep learning models. Transfer learning helps to transfer the learning of a pre-trained model to a new model. Transfer learning has been used in various applications, such as tumor classification, software defect prediction, activity recognition and sentiment classification. In this, the performance of the proposed Deep CNN model has been compared with popular transfer learning approach VGG16.

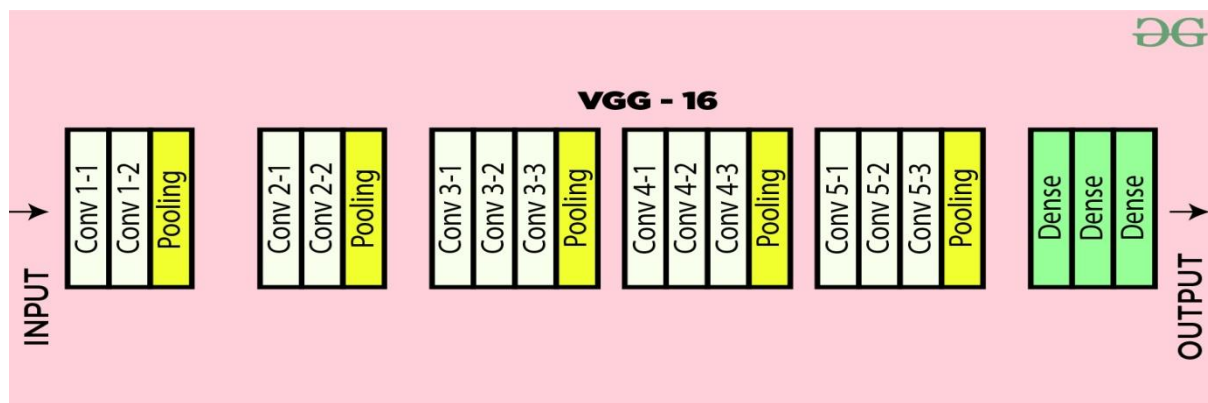


Fig.9. VGG16 layered architecture[20]

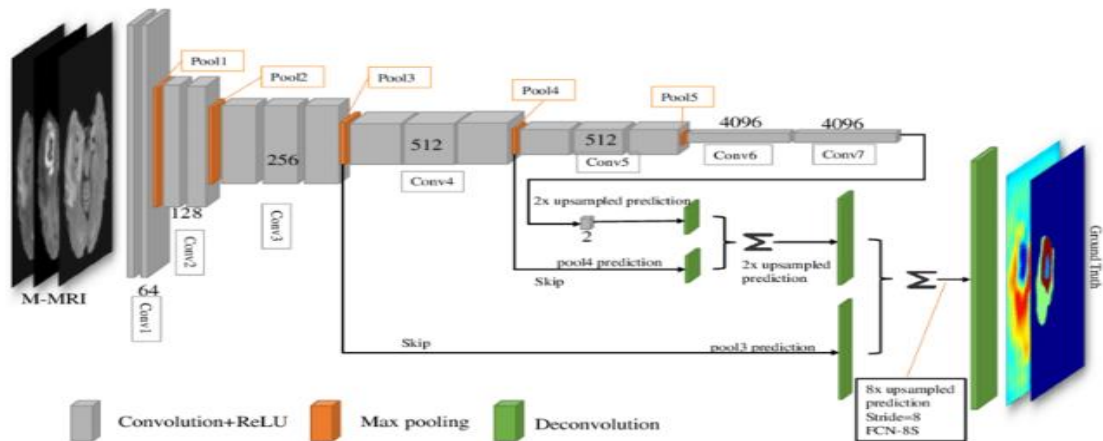


Fig.10. Working of VGG16 model for brain tumor detection [14]

VGG16 is a convolutional neural network. The input of the 1 convolution layer is of fixed size 224 x 224 RGB image. The image is passed through a stack of convolutional layers, where the filters are used with a very small receptive field 3×3 (which is the smallest size to capture the notion of left/right, up/down, center). In the configurations, it is also utilizes 1×1

convolution filters, and it can be seen as a linear transformation of the input channels. The convolution stride is fixed to 1 pixel, and the spatial padding of convolution. Input layer is the spatial resolution is preserved after convolution, i.e. the padding is 1-pixel for  $3 \times 3$  convolution layers. Spatial pooling is carried out by five max-pooling layers, which follow the some convolution layers (not all the conv. layers are followed by max-pooling). Max-pooling is performed over  $2 \times 2$  pixel window, with stride 2.

Three Fully-Connected (FC) layers are follow a stack of convolutional layers which has a different depth in different architectures and the first two have 4096 channels each, the third performs 1000-way ILSVRC classification and it contains 1000 channels one for each class. The final layer is the soft-max layer. The configuration of the fully connected layers is same in every network.

All hidden layers are equipped with the rectification (ReLU) nonlinearity. It is also noted that none of the networks (except for one) contain Local Response Normalization (LRN), such normalization does not improve the performance on the ILSVRC dataset, but leads to increased memory consumption and computation time.

## 4. DATASET, IMPLEMENTATION AND RESULT

### 4.1: DATASET DETAIL

The dataset has 556 images with different types of tumor and also including images which has tissues of Fat or water.

1. DICOM Samples Image Sets, <http://www.osirix-viewer.com/>. [3]
2. “Brainweb:SimulatedBrainDatabase,”  
<http://brainweb.bic.mni.mcgill.ca/cgi/brainweb1>. [4]

### 4.2: TOOLS & TECHNOLOGY USED

- **Python:** Python was the language of selection for this project. This was a straightforward call for many reasons.
1. Python as a language has a vast community behind it. Any problems which may be faced is simply resolved with a visit to Stack Overflow. Python is among the foremost standard language on the positioning that makes it very likely there will be straight answer to any question
  2. Python has an abundance of powerful tools prepared for scientific computing Packages like NumPy, Pandas and SciPy area unit freely available and well documented. Packages like these will dramatically scale back, and change the code required to write a given program. This makes iteration fast.
  3. Python as a language is forgiving and permits for program that appear as if pseudo code. This can be helpful once pseudo code given in tutorial papers must be enforced and tested. Using python this step is sometimes fairly trivial. However, Python is not without its errors. The language is dynamically written and packages are area unit infamous for Duck writing. This may be frustrating once a package technique returns one thing that, for instance, looks like an array instead of being an actual array. Plus the actual fact that standard Python documentation does not clearly state the return type of a method, this can lead to a lot of trials and error testing that will not otherwise happen in a powerfully written language. This is a problem that produces learning to use a replacement Python package or library more difficult than it otherwise may be.

- **Jupyter Notebook:** The Jupyter Notebook is an open-source web application that enables you to make and share documents that contain live code, equations, visualizations and narrative text. Uses include: data cleaning and transformation, numerical simulation, statistical modelling, data visualization, machine learning, and much more.
- **Noise Removal and Sharpening:** Unwanted data of element are remove using filter and image Can be sharpen and black and white gray scale image is used as a input.
- **Erosion and Dilation:** It is applied to binary image, but there are many versions so that can be work on grayscale images. The basic effect of the operator on a binary image is eroding away to the boundaries of regions for ground pixels.
- **Negation:** A negative is an image, usually it used on a strip or sheet of transparent plastic film, in negation the lightest areas of the photographed subject appear darkest and the darkest areas appear lightest.
- **Subtraction:** Image subtraction process is the digital numeric value of one pixel or whole image is subtracted from another image. The white part of tumor can be subtracted from another remaining part that is the black portion of the images.
- **Threshold:** Thresholding is a process of image segmentation. It converts the gray scale image into binary image.
- **Boundary Detection:** Total area or boundary can be form properly using boundary detection method. White part of tumor tissues can be highlighted and there proper boundary can be detected. It is useful method to calculate the size and shape occupy by tumor tissues.

### 4.3: RESULTS

- **Give the label of the image**

```
<built-in function dir>
/content/drive/My Drive/brain_dataset/yes
X_data shape: (235, 224, 224, 3)
y_data shape: (235,)
<built-in function dir>
/content/drive/My Drive/brain_dataset/no
X_data shape: (413, 224, 224, 3)
y_data shape: (413,)
```

Fig.11.Label of the image

These outputs in images are resized and give label name to all images.

- **Split the Data**

```
X_data shape: (330, 224, 224, 3)
X_data shape: (83, 224, 224, 3)
Y_data shape: (330,)
Y_data shape: (83,)
```

Fig.12.Split the image data

Fig 12. Contain Total 413 dataset images are divided into two parts 330 are in training part and 83 is the testing part.

- **Train Data**

```
Epoch 245/250
15/15 [=====] - 48s 3s/step - loss: 0.4972 - accuracy: 0.7542 - val_loss: 0.5175 - val_accuracy: 0.8485
Epoch 246/250
15/15 [=====] - 48s 3s/step - loss: 0.5008 - accuracy: 0.7374 - val_loss: 0.5198 - val_accuracy: 0.7879
Epoch 247/250
15/15 [=====] - 52s 3s/step - loss: 0.4825 - accuracy: 0.7879 - val_loss: 0.5250 - val_accuracy: 0.7879
Epoch 248/250
15/15 [=====] - 48s 3s/step - loss: 0.4977 - accuracy: 0.7407 - val_loss: 0.5130 - val_accuracy: 0.8182
Epoch 249/250
15/15 [=====] - 48s 3s/step - loss: 0.4789 - accuracy: 0.7542 - val_loss: 0.5168 - val_accuracy: 0.8788
Epoch 250/250
15/15 [=====] - 48s 3s/step - loss: 0.4849 - accuracy: 0.7441 - val_loss: 0.5262 - val_accuracy: 0.7879
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/python/ops/resource_variable_ops.py:1817: calling BaseResourceVari
Instructions for updating:
If using Keras pass * constraint arguments to layers.
```

Fig.13.Train CNN image data

Fig . 13. Consist output of train the convolutional neural network. Train 330 samples and validate on 150 samples

- **Test Data**

```
scores=model.evaluate(xTest, yTest)
print("%s: %2f%%" %(model.metrics_names[1], scores[1]*100))
```

```
3/3 [=====] - 2s 808ms/step - loss: 0.5499 - accuracy: 0.8072
accuracy: 80.722892%
```

Fig.14.Test CNN image Data

Fig 14. Consist output of convolutional neural network testing accuracy score 80.72%

- **Train Data**

```
Epoch 65/70
20/20 [=====] - 338s 17s/step - loss: 0.5633 - accuracy: 0.7473
Epoch 66/70
20/20 [=====] - 329s 16s/step - loss: 0.5276 - accuracy: 0.7677
Epoch 67/70
20/20 [=====] - 333s 17s/step - loss: 0.5474 - accuracy: 0.7382
Epoch 68/70
20/20 [=====] - 329s 16s/step - loss: 0.5726 - accuracy: 0.7524
Epoch 69/70
20/20 [=====] - 340s 17s/step - loss: 0.5436 - accuracy: 0.7598
Epoch 70/70
20/20 [=====] - 326s 16s/step - loss: 0.5467 - accuracy: 0.7587
```

Fig.15.Test VGG16 image Data

Fig . 15. Consist output of train the VGG 16 Transfer Learning model. Train 330 samples and validate on 150 samples

- **Test Data**

```
model.save('braintransfer-VGG70.model')
scores=model.evaluate(xTest, yTest)
print("%s: %2f%%" %(model.metrics_names[1], scores[1]*100))

83/83 [=====] - 42s 500ms/step
accuracy: 85.542166%
```

Fig.16.Test VGG16 image Data

Fig 16. Consist output of VGG 16 testing accuracy score 85.54%

- **Implementation: CNN model summary**

```
Model: "sequential_1"
```

Layer (type)	Output Shape	Param #
conv2d_4 (Conv2D)	(None, 254, 254, 32)	896
max_pooling2d_4 (MaxPooling2)	(None, 127, 127, 32)	0
dropout_5 (Dropout)	(None, 127, 127, 32)	0
conv2d_5 (Conv2D)	(None, 125, 125, 64)	18496
max_pooling2d_5 (MaxPooling2)	(None, 62, 62, 64)	0
dropout_6 (Dropout)	(None, 62, 62, 64)	0
conv2d_6 (Conv2D)	(None, 60, 60, 128)	73856
activation_3 (Activation)	(None, 60, 60, 128)	0
max_pooling2d_6 (MaxPooling2)	(None, 30, 30, 128)	0
dropout_7 (Dropout)	(None, 30, 30, 128)	0
conv2d_7 (Conv2D)	(None, 28, 28, 512)	590336
activation_4 (Activation)	(None, 28, 28, 512)	0
max_pooling2d_7 (MaxPooling2)	(None, 14, 14, 512)	0
dropout_8 (Dropout)	(None, 14, 14, 512)	0
flatten_1 (Flatten)	(None, 100352)	0
dense_2 (Dense)	(None, 64)	6422592
dropout_9 (Dropout)	(None, 64)	0
dense_3 (Dense)	(None, 1)	65
activation_5 (Activation)	(None, 1)	0
Total params: 7,106,241		
Trainable params: 7,106,241		
Non-trainable params: 0		

```
None
```

Table.1. CNN model summary table

- IMPLEMENTATION: VGG16 MODEL SUMMARY**

Model: "sequential\_1"

Layer (type)	Output Shape	Param #
=====	=====	=====
vgg16 (Model)	(None, 7, 7, 512)	14714688
flatten_1 (Flatten)	(None, 25088)	0
dropout_1 (Dropout)	(None, 25088)	0
dense_1 (Dense)	(None, 1)	25089
=====	=====	=====
Total params: 14,739,777		
Trainable params: 25,089		
Non-trainable params: 14,714,688		
None		

Table. 2. Transfer learning VGG16 model summary

- IMPLEMENTATION: COMPARISON CNN ACCURACY WITH VGG16 ACCURACY**

epochs	CNN	VGG 16
30	67.469877%	76.854917%
50	69.87952%	81.927711%
70	72.698794%	85.542166%

Table 3. Comparison table of CNN vs. VGG16



- **IMPLEMENTATION: CNN VS. TRANSFER LEARNING(VGG16)**  
**ACCURACY CHART**

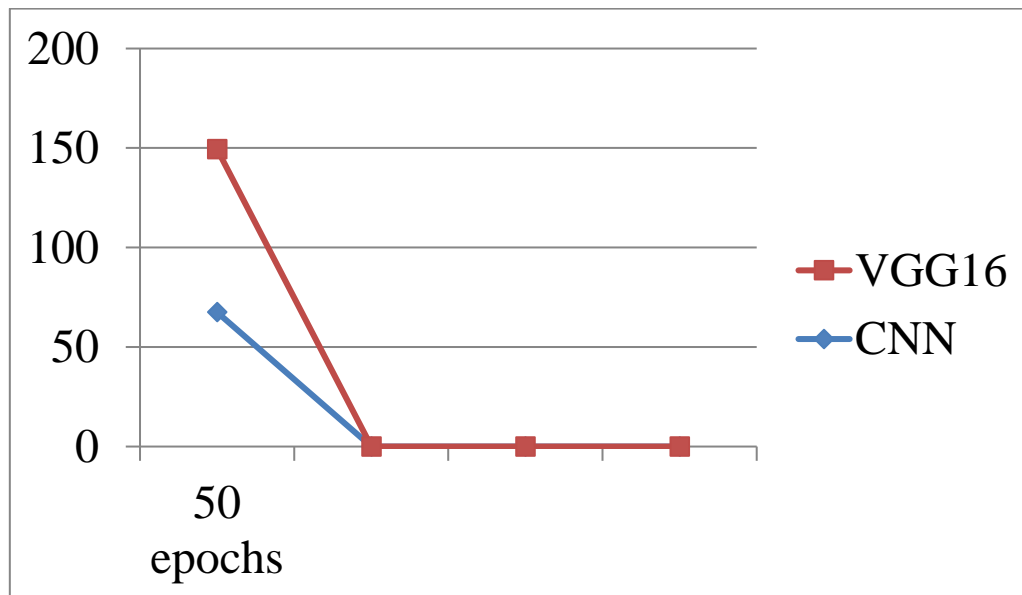


Fig.17. Chart of CNN vs. VGG16

## 5. CONCLUSION

In brain tumor detection we have studied about feature based existing work. In feature based we have study about image processing techniques likes image pre-processing, image segmentation, features extraction, classification. And also study about deep learning techniques CNN and VGG16. In this system we have detect the tumor is present or not if the tumour is present then model return's yes otherwise it return no. and we have compared CNN with the VGG 16 Model. The result of comparison VGG 16 is more accurate than CNN. However, not every task is said to be perfect in this development field even more improvement may be possible in this application. I have learned so many things and gained a lot of knowledge about development field.

## References

- [1] L. Guo, L. Zhao, Y. Wu, Y. Li, G. Xu, and Q. Yan, "Tumor detection in MR images using one-class immune feature weighted SVMs," *IEEE Transactions on Magnetics*, vol. 47, no. 10, pp. 3849–3852, 2011.
- [2] R. Kumari, "SVM classification an approach on detecting abnormality in brain MRI images," *International Journal of Engineering Research and Applications*, vol. 3, pp. 1686–1690, 2013.
- [3] DICOM Samples Image Sets, <http://www.osirix-viewer.com/>.
- [4] "Brainweb: Simulated Brain Database"  
<http://brainweb.bic.mni.mcgill.ca/cgi/brainweb1>.
- [5] Obtainable Online: [www.cancer.ca/~media/CCE](http://www.cancer.ca/~media/CCE) 10/08/2015.
- [6] J. C. Buckner, P. D. Brown, B. P. O'Neill, F. B. Meyer, C. J. Wetmore, J. H. Uhm, "Central nervous system tumors." In *Mayo Clinic Proceedings*, Vol. 82, No. 10, pp. 1271-1286, October 2007.
- [7] Deepa, Singh Akansha. (2016). - Review of Brain Tumor Detection from tomography. *International Conference on Computing for Sustainable Global Development (INDIACom)*
- [8] R. A. Novellines, M. D. - *Squire's fundamentals of radiology*; Six Edition; UPR, 2004.
- [9] preston, D. c. (2006). Magnetic Resonance Imaging (MRI) of the Brain and Spine from Basics. *casemed.case.edu*.
- [10] Hendrik RE. (2005) Glossary of MR Terms from *American College of Radiology*.
- [11] A. Demirhan, M. Toru, and I. Guler, "Segmentation of tumor and edema along with healthy tissues of brain using wavelets and neural networks," *IEEE Journal of Biomedical and Health Informatics*, vol. 19, no. 4, pp. 1451–1458, 2015.

- [12] Nilesh Bhaskarrao Bahadure, A.K. (2017, March 6). Retrieved from <https://www.hindawi.com/journals/ijbi/2017/9749108/>.
- [13] S. Mohsin, S. Sajjad, Z. Malik, and A. H. Abdullah, "Efficient way of skull stripping in MRI to detect brain tumor by applying morphological operations, after detection of false background," *International Journal of Information and Education Technology*, vol. 2, no. 4, pp. 335–337, 2012.
- [14] Gavale, P. M., Aher, P. V., & Wani, D. V. (2017, April 4). Retrieved from <https://www.irjet.net/archives/V4/i4/IRJET-V4I462.pdf>.
- [15] N. Gordillo, E. Montseny, and P. Sobrevilla, "State of the art survey on MRI brain tumor segmentation," *Magnetic Resonance Imaging*, vol. 31, no. 8, pp. 1426–1438, 2013.
- [16] Samantaray, M.(2016, November 3). Retrieved from <http://ieeexplore.ieee.org/document/7727089/> .
- [17] Nandi, A. (2016, April 11) Retrieved from <http://ieeexplore.ieee.org/document/7449892/>
- [18] C. C. Benson and V. L. Lajish, "Morphology based enhancement and skull stripping of MRI brain images," in *Proceedings of the international Conference on Intelligent Computing Applications (ICICA '14)*, pp. 254–257, Tamilnadu, India, March 2014.
- [19] S. Z. Oo and A. S. Khaing, "Brain tumor detection and segmentation using watershed segmentation and morphological operation," *International Journal of Research in Engineering and Technology*, vol. 3, no. 3, pp. 367–374, 2014.
- [20] R. Roslan, N. Jamil, and R. Mahmud, "Skull stripping magnetic resonance images brain images: region growing versus mathematical morphology," *International Journal of Computer Information Systems and Industrial Management Applications*, vol. 3, pp. 150–158, 2011.

**APPENDIX A ABBRAVIATION**

Sr No.	Abbreviation	Meaning
1	CNN	Convolutional neural network
2	MRI	Magnetic resonance imaging
3	FLAIR	Fluid attenuated in version recovery weighted MRI
4	TR	Time repetition
5	TE	Pulse sequence parameter
6	VGG 16	Visual Geometry Group
7	FC	Fully connected layer
8	ReLU	Rectified linear unit
9	LRN	Local response normalization
10	SVM	Support vector machine
11	KNN	K nearest neighbor

## APPENDIX B REVIEWCARD

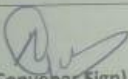



**BIRLA VISHVAKARMA MAHAVIDYALAYA**  
(An Autonomous Institute)  
**M. Tech. Computer Engineering (Software Engineering)**  
**Dissertation-II Internal Review card**

Semester: 4<sup>th</sup> AY: 2019-20

ID No: 18CP813 Name of the Student: Pazomas Ankita D.  
Title of the Dissertation: Brain Tumor Detection using CNN

Dr. N.M. Patel M.K. Jaisiya Dr. Melfuzeshan Prof. Prunay Patel  
Name of Convener Name of Member Name of Guide Name of Guide

Mid Semester Review-1		Date: <u>9/3/2020</u>
No.	Comments given by DPC Members	Modification done based on Comments
1	Increase size of dataset	
2	Fine tune the model by varying layers, filter size etc.	
3	Prepare & publish the survey paper	

 (Convener Sign)
  (Member Sign)
  (Guide Sign)
  (Guide Sign)

Mid Semester Review-2		Date: _____
No.	Comments given by DPC Members	Modification done based on Comments

(Convener Sign) (Member Sign) (Guide Sign) (Guide Sign)

Page 1 of 1  
2020-7-30 09:10

## APPENDIX C



### Document Information

---

Analyzed document	final report 18CP813.pdf (D76347503)
Submitted	7/14/2020 6:17:00 AM
Submitted by	BVM Engineering College
Submitter email	mec008owner@gtu.edu.in
Similarity	20%
Analysis address	mec008owner.gtuni@analysis.urkund.com

### Sources included in the report

---

 W	URL: <a href="https://www.irjet.net/archives/V4/i4/IRJET-V4I462.pdf">https://www.irjet.net/archives/V4/i4/IRJET-V4I462.pdf</a> Fetched: 7/14/2020 6:20:00 AM	 9
 W	URL: <a href="https://www.researchgate.net/publication/272985340_A_review_on_various_brain_tumor_...">https://www.researchgate.net/publication/272985340_A_review_on_various_brain_tumor ...</a> Fetched: 7/14/2020 6:20:00 AM	 4
 W	URL: <a href="https://link.springer.com/article/10.1007/s10916-019-1368-4?shared-article-renderer">https://link.springer.com/article/10.1007/s10916-019-1368-4?shared-article-renderer</a> Fetched: 7/14/2020 6:20:00 AM	 1

## APPENDIX D



**International Journal of Advance Engineering  
and Research Development (IJAERD)**  
Impact Factor: 5.71 (SJIF-2017)  
DOI: 10.21090/IJAERD  
ISSN (Online): 2348-4470  
Contact No: +91-9033132543  
ISSN (Print): 2348-6406  
Email id: editor.ijaerd@gmail.com  
Website: www.ijaerd.com

---

Ref No: IJAERD/AL/Vol.7/Issue04/54648  
Date: 16-04-2020

**"ACCEPTANCE LETTER"**

Certified that Review/Research PAPER ID: 54648 TITLED "A SURVEY ON BRAIN TUMOR DETECTION USING DEEP LEARNING" AUTHORS PARMAR ANKITA, DR. MEHFUZA S. HOLIA, PRANAY S PATEL has been accepted to publish in International Journal of Advance Engineering and Research Development (IJAERD) in Volume- 07, Issue-04 of April 2020

  
Chief Editor  
IJAERD  
E-mail (s): editor.ijaerd@gmail.com

\*Note: "The Validity of acceptance letter only five days after paper acceptance"