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# DEEP LEARNING MODELS FOR BRAIN TUMOR DETECTION

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**ABSTRACT**

Brain tumors have recently emerged as one of the most critical issues for individuals suffering from severe headaches. However, most people are concerned that their headache is the result of a serious problem, such as a brain tumor, especially if they experience severe pain on a regular basis. In general, practically all brain tumors do not induce headaches since the brain has the ability to modulate discomfort. Some tumor cause more frequent headaches if the patient's brain contains a large tumor that puts pressure on nerves. A brain tumor is a sort of abnormal cell that develops in the human brain and is always classified as benign or malignant. If the tumor is detected in its early stages and therapy is initiated, the quality of life and life spam may improve. There is currently a high need for brain tumor diagnosis using various machine learning and deep learning techniques. With the advancement of artificial intelligence, deep learning models are being used to diagnose brain tumors using magnetic resonance imaging pictures. Magnetic resonance imaging (MRI) is a sort of scanning procedure that produces detailed images of the inner body by using powerful magnetic fields and radio waves. Deep learning methods such as convolutional neural network (CNN) models and VGG-16 architecture (developed from scratch) are used in this study to locate tumor regions in scanned brain pictures. We looked at brain MRI scans from 253 patients, 155 of which were tumors and 98 of whom were not. The research compares the outputs of the CNN model and the VGG-16 architecture used.

**KEY WORDS:**

Brain Tumors, Magnetic Resonance Imaging, VGG-16, Convolutional Neural Network (CNN) Model, Deep Learning Model, Abnormal Cell

## 1. INTRODUCTION

In general there are two types of brain tumors: benign (non-cancerous) and malignant (cancerous). Once formed in the human brain, these tumors will attempt to develop a malignant nature in their brain and act as a spreading agent for all other tiny tissues existing in the human brain, so worsening the patients' health [1]-[5].In general, when cells get old or injured internally, they are killed; some are replaced by the nervous system. If cells that are nearly damaged or old are unable to be cleared from the human brain, significant difficulties may arise, leading to tumor formation. The tumor is a huge item that grows inside the brain and becomes more difficult to detect. If the tumor is detected and treated in its early stages, the patient's health can recover and return to normal. If the diagnosis is not treated early on, there is a very low likelihood of the patient recovering and an increase in life spam.Computertomography or magnetic imaging is used to diagnose patients, and medical professionals will attempt to trace tumors throughout this procedure. The outcome will be replicated in the form of MRI pictures, providing accurate images of the human brain for case evaluation. Because of its better contrast in soft tissue in humans, MRI pictures always yield more accurate results than other imaging techniques such as computed tomography (CT).

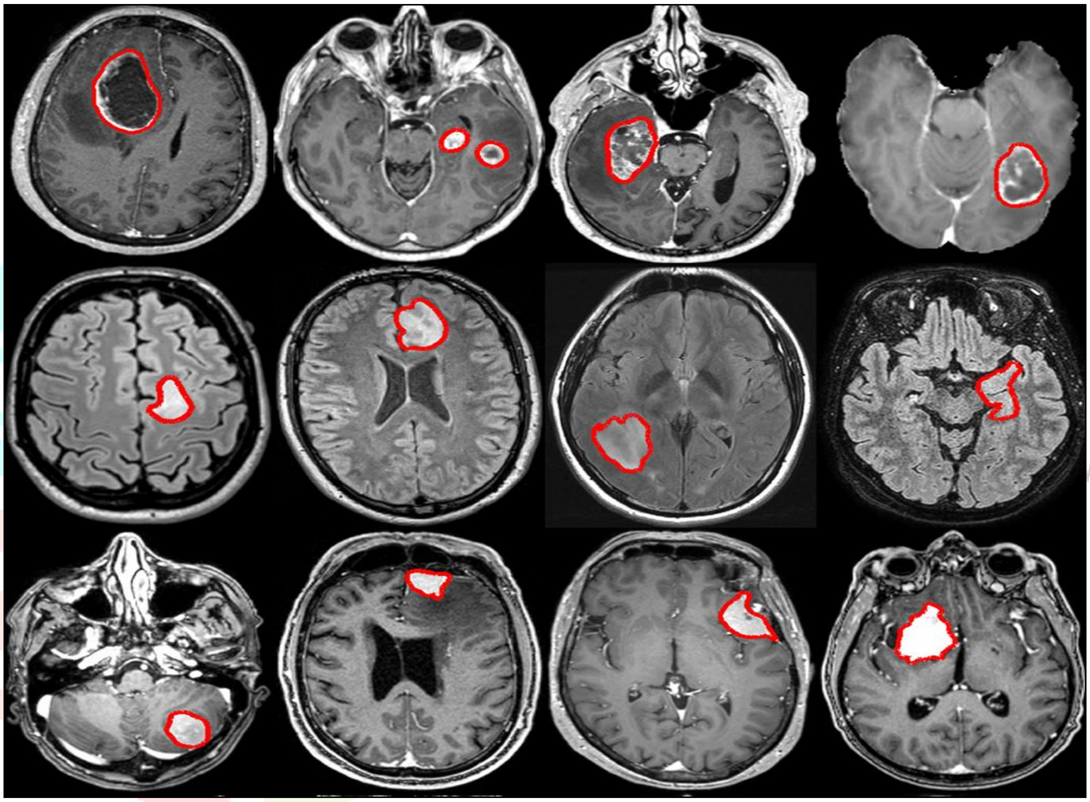


**Figure 1. Brain MRI for identifying the Presence of Tumor Cells**

From the above figure 1, we can clearly identify brain MRI images contain several regions which are marked with red color and those are identified as tumors present inside the brain. . Some tumor cause more frequent headaches if the patient's brain contains a large tumor that puts pressure on nerves.

The most crucial task is identifying the affected region of the human brain using images or scan data. This should be done under the supervision of medical experts who are experienced in examining medical images obtained from an MRI scan. Because MRI images are so complex in structure and representation, the human eye cannot discern the tiny or minute defects that exist within the nervous system. As a result, we try to employ Computer Aided Diagnosis (CAD) systems to discover and diagnose the problem; these are usually used by radiologists to detect tumors in the human body. In general, much study is being conducted in attempt to segment and classify the tumors found in the body. Hence this motivated me to design this application in which we can able to detect the brain tumor from MRI scan images using any deep learning models so that without any prior knowledge of radiologist we can able to trace the problem and provide remedies for that problem.

## 2. LITERATURE SURVEY

This section will deal with all the previous information related to brain tumor and several methods for identifying the brain tumor. Literature survey is the most important step in software development process. For any software or application development, this step plays a very crucial role by determining the several factors like time, money, effort, lines of code and company strength. Once all these several factors are satisfied, then we need to determine which operating system and language used for developing the application. Once the programmers start building the application, they will first observe what are the pre-defined inventions that are done on same concept and then they will try to design the task in some innovated manner.

**MOTIVATION**

MudassarRaza.et al. [17] presented a study on brain tumor diagnosis using extreme learning in 2020. The authors attempt to describe triangular fuzzy median filtering and its usefulness in image enhancement for unsupervised fuzzy set method segmentation in this study. In this suggested work, all Gabor features from each individual candidate's lesions are detected, and comparable texture (ST) features are calculated. These retrieved features are fed into the tumor classification extreme learning machine (ELM). The proposed technique is tested on BRATS difficult datasets from 2012, 2013, 2014, and 2015, as well as the 2013 Leader board. The presented results clearly show that our approach yields better outcomes and can detect tumors in much less time.

Gopal S. Tandel. et al. [15] proposed a study in 2019 titled Review on a Deep Learning Perspective on Brain Cancer Classification. In this study, the author attempts to discuss brain imaging and what scans are performed on brain images to discover cancer or tumors that are present in the human brain. The brain picture is first scanned using methods such as magnetic resonance imaging (MRI), computed tomography (CT), and other imaging modalities. The authors attempt to summaries the pathophysiologic of brain cancer, imaging modalities of brain cancer, and automatic computer assisted approaches for brain cancer characterization in a machine and deep learning paradigm in this current study.

Vaibhavi Solanki et al. [14] published a study on Brain MRI Image Classification Using Image Mining Algorithms in 2018. They developed an enhanced image mining technique for brain tumor classification utilising an association rule mining algorithm similar to the MARI algorithm in this study. This proposed method is mostly useful for identifying the association rule mining technique in order to classify CT scan brain images into three distinct groups such as normal, benign, and malignant. It is used to merge very low level features taken from photos obtained from medical specialists. The experimental results using a Pre-Diagnosed database including brain images revealed that the input database has 97 percent sensitivity and 94 percent accuracy.

## 3. EXISTING METHODOLOGY

In the first stage, computer-based processes are used to locate tumor blocks and classify the type of tumor in MRI scans of various patients using the Artificial Neural Network Algorithm. The second stage comprises the application of various image processing techniques such as histogram equalization, image segmentation, image enhancement, morphological operations, and feature extraction for cancer-affected patients' brain tumor diagnosis in MRI images. This study developed one automatic brain tumor detection approach to improve accuracy and shorten diagnosis time.

**LIMITATION OF EXISTING SYSTEM**

1. The classification produces the less accuracy.
2. The existing approach uses manual approach to find out the brain tumor from MRI images.
3. It requires lot of manual effort to diagnose and only radiologist or doctors can understand the MRI images and detect the problem.
4. This is accurate if we use for less dimensions
5. This is not accurate for large dimensional dataset by using primitive methods.

## 4. PROPOSED SYSTEM & ITS ADVANTAGES

The suggested system consists mostly of five modules. Pre-processing, Dataset Build a CNN model, train a Deep Neural network for epochs, then classify the data. We can take many MRI pictures and use one as the input image in the dataset. To encode the label and resize the image during pre-processing. We configured the image to be 80% Training Data and 20% Testing Data when splitting the data. Then, for each epoch, build a CNN model and train a deep neural network. The image was then assessed as yes or no; if the tumor is positive, it returns yes; if the tumor is negative, it returns no.

**ADVANTAGES OF PROPOSED SYSTEM:**

The following are the benefits of the proposed system. They are:

1. The results obtained by the CNN Model are best compared to Primitive Methods.
2. The accuracy is increased using VGG-16 model
3. We can optimize the error rate using VGG-16

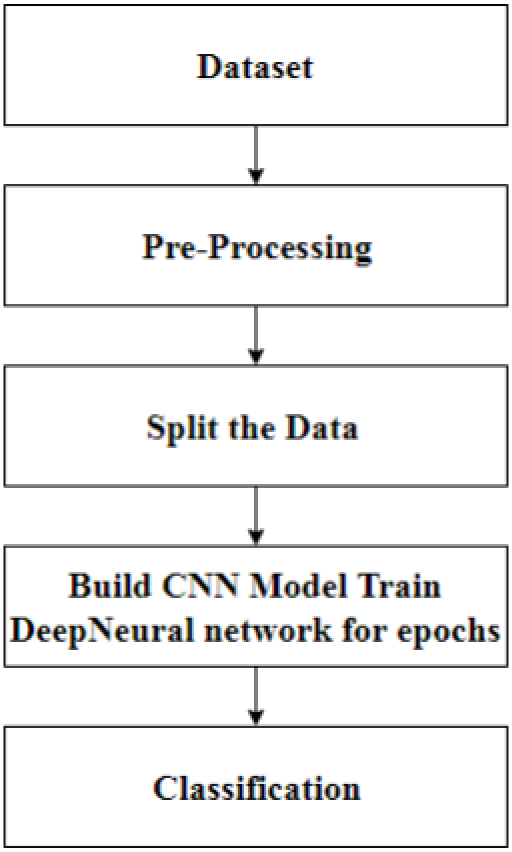



**Figure 2. Denotes the Proposed Architecture**

## 5. PROPOSED ALGORITHMS

In this proposed application we try to implement VGG-16 model for detecting the brain tumor from Brain MRI Images.

**VGG-16 MODEL**

It was one of the first CNN architectures to demonstrate excellent performance on image classification tasks and has since become a popular benchmark for image recognition.VGG16 has a total of 16 layers, including 13 convolutional layers and 3 fully connected layers. The convolutional layers are arranged in blocks of two or three, with each block followed by a max-pooling layer. The filters in the convolutional layers have a very small receptive field of 3x3 pixels and are padded to preserve the spatial dimensions of the input.The VGG16 architecture has been pre-trained on the ImageNet dataset, which consists of over 1 million labeled images across 1,000 categories. The pre-trained weights can be fine-tuned on a smaller dataset for a specific image classification task. In [9], the deep VGG16 model trained with transfer learning, which achieves an overall accuracy of 90.4%

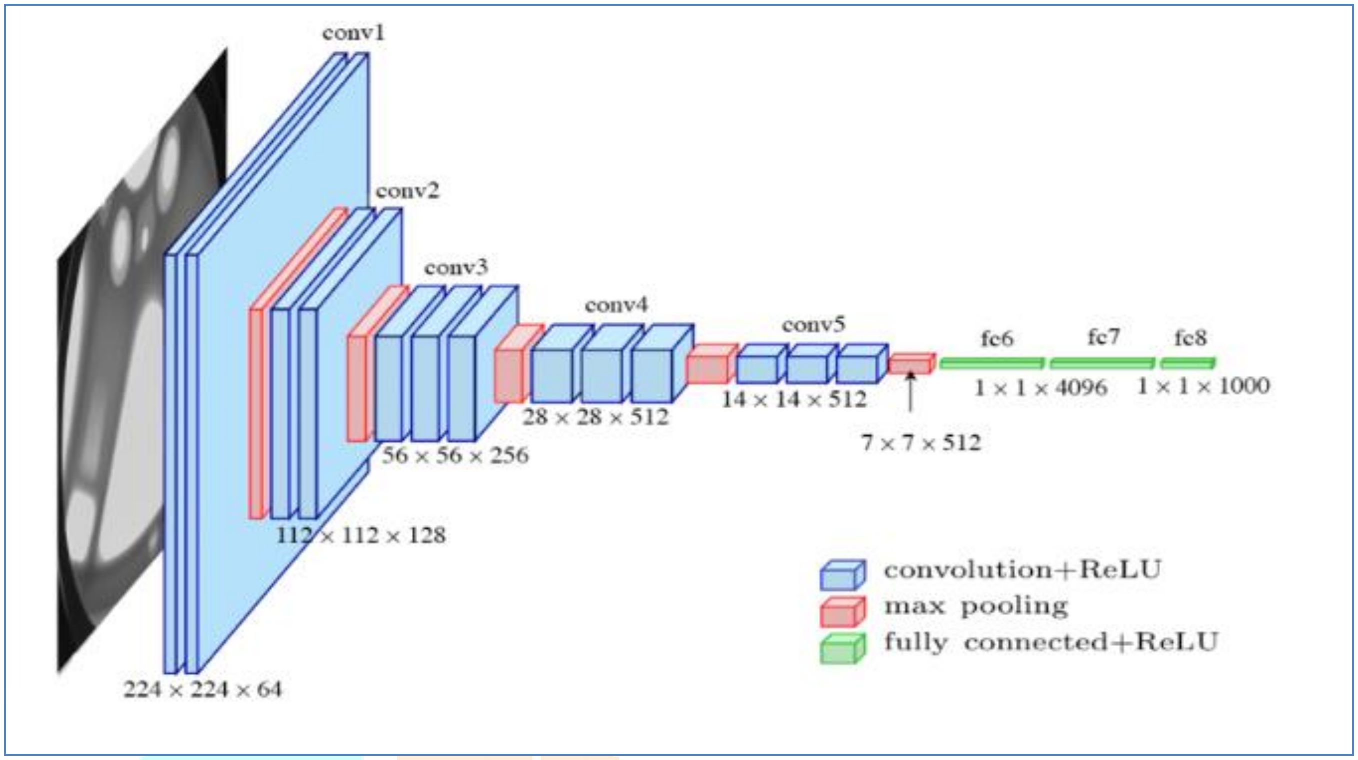



**Figure 3. Denotes the Proposed VGG-16 Architecture**

Figure 3, clearly state the CNN architecture using VGG model for finding the brain tumor based on MRI Images.

## 6. IMPLEMENTATION PHASE

The step of implementation is when the theoretical design is translated into a programmatically-based approach. The application will be divided into a number of components at this point and then programmed for deployment. The front end of the application takes Google Collaboratory and as a Back-End Data base we took MRI Brain Images as input dataset. Python is being used in this instance to implement the present application. The following five modules make up the bulk of the application. They are listed below:

1. Load Dataset Module
2. Generate Test and Train Data
3. Run Pre-Trained CNN Models
4. Brain Tumor Detection from Test Dataset

**1) LOAD DATASET MODULE:**

We attempt to load the dataset from the KAGGLE website in this module, and then we downloaded the dataset from : https://www.kaggle.com/datasets/navoneel/brain-mri-images-for-brain-tumor-detection

**2) GENERATE TEST & TRAIN MODULE**

Here, we attempt to split the data into test and training datasets, and we employed a 70:30 ratio to break the large dataset up into smaller chunks. In this case, 70% of the data records are used to train the system, while 30% of the data are utilised to test the model.

**3) RUN CNN MODELS MODULE**

In this instance, we attempt to run CNN models on the train dataset and verify the likelihood of each and every attribute contained in that record. After all the records have been analysed, we try to execute VGG-16 model on the input dataset and now we try to detect whether tumor is present or not.

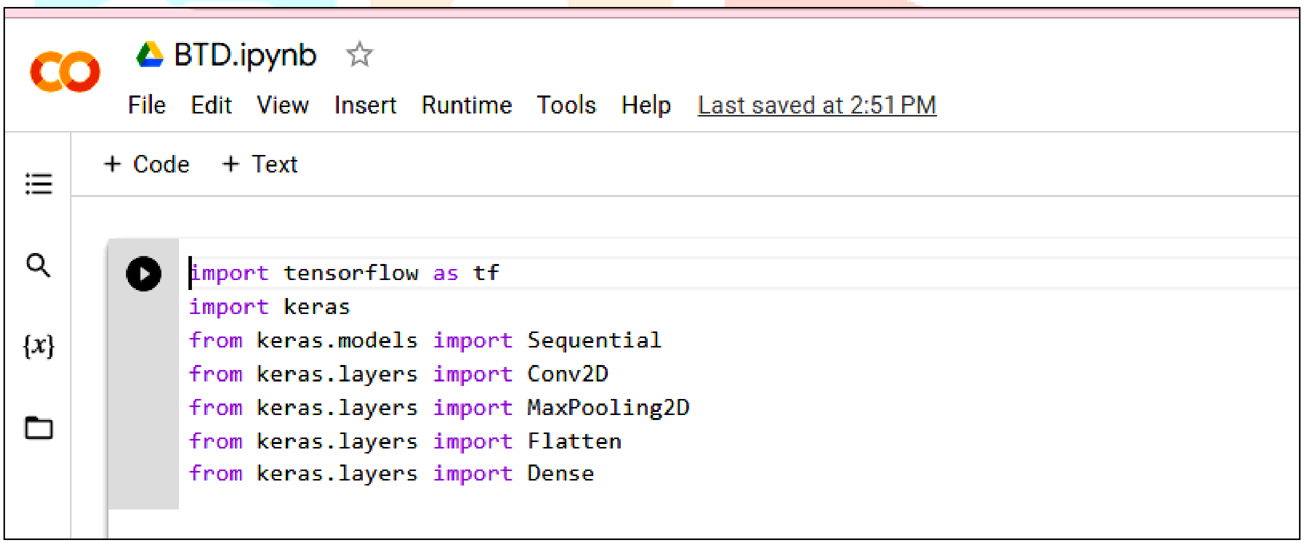
**4) BRAIN TUMOR DETECTION FROM TEST DATASET**

After all the records have been analysed, we now try to identify which Brain MRI image is contained with tumor cells and which image is having normal features. Based on this application we can able to find out the tumor from any MRI images.

## 7. EXPERIMETAL REPORTS

In this proposed application, we try to use google collab as working platform and try to show the performance of our proposed application.

**1) IMPORT LIBRARIES AND VIEW FILE CONTENT**



**2) APPLY DEEP LEARNING MODEL**

```
classifier.fit_generator(training_set, steps_per_epoch=None, epochs=100, verbose=1, callbacks=None, validation_data=test_set,

Epoch 1/100
1/1 [==============================] - 0s 265ms/step - loss: 0.6989 - acc: 0.4545 - val_loss: 0.6783 - val_acc: 0.5714
Epoch 2/100
1/1 [==============================] - 0s 85ms/step - loss: 0.7245 - acc: 0.5909 - val_loss: 0.6657 - val_acc: 0.5714
Epoch 3/100
1/1 [==============================] - 0s 92ms/step - loss: 0.6643 - acc: 0.5909 - val_loss: 0.6835 - val_acc: 0.7143
Epoch 4/100
1/1 [==============================] - 0s 96ms/step - loss: 0.6570 - acc: 0.6364 - val_loss: 0.6919 - val_acc: 0.4286
Epoch 5/100
1/1 [==============================] - 0s 95ms/step - loss: 0.6660 - acc: 0.6364 - val_loss: 0.6866 - val_acc: 0.4286
Epoch 6/100
```

**3 ) TEST INPUT WITH MRI BRAIN IMAGE**

```
import numpy as np
from keras.preprocessing import image
test_image = image.load_img('/home/telraswa/Desktop/Swapnil/manju_project/TestImages/brain-tumors-fig
test_image
```

**4) PREDICT THE OUTCOME**

```
[ ] training_set.class_indices

{'Benign': 0, 'Malignant': 1}
```

```
if result[0][0] == 0:
    prediction = 'Benign'
else:
    prediction = 'Malignent'
print("Detected tumor type is %s"%prediction)

Detected tumor type is Malignent
```

## 8. CONCLUSION

CNN is regarded as one of the most effective techniques for analysing picture datasets. The CNN predicts by lowering the size of the image without sacrificing the information required for prediction. The ANN model produced here has a testing accuracy of 65.21%, which can be boosted by giving more image data. The same thing can be done by using picture augmentation techniques and analysing the performance of the ANN and CNN. The model built here was created using the trial and error method. In the future, optimization techniques could be used to determine the amount of layers and filters that can be utilised in a model. As of today, CNN is the best fit for the supplied dataset better technique for predicting the presence of brain tumor.

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