BRAIN TUMOUR IDENTIFICATION USING CONVOLUTIONAL NEURAL NETWORKS

Submitted by

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CHENNAI

Declaration

Certified that this project report titled “BRAIN TUMOUR IDENTIFICATION USING CONVOLUTIONAL NEURAL NETWORK” is a Bonafide work of Sai Nithin, Raghavendra and Abhishek carried out the Project work under my supervision and guidance.

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Abstract

Brain tumor is a collection of abnormal cells in our brain. Tumor detection is one of the most important fields in medical science because brain tumor affects the normal functioning of the human body. Medical imaging technique plays a crucial role in identifying the tumor cells. With the help of CT scan and MRI imaging technique, the images of the brain can be obtained. This project is also conveyed us by knowing, artificial intelligence is helpful in solving real life problems. This project gives us the way to find the Brain Tumor by using CNN algorithm and another some classification algorithms and methods. Detection of Brain Tumor through some automatic technique is beneficial as it requires a large amount of work of monitoring by doctors, and at very early stage itself it detects symptoms of diseases means we can cure easily. In order to detect the Tumor some steps are to be followed using image processing. Detection of Brain Tumor will help to. This also makes the development of artificial intelligence technology in solving real life problems in model of machine level. The Algorithms we are using here are transfer learning algorithms like VGG19 and MobileNet Model and also a model CNN Model which we have built. To identify the brain tumor, scanned MRI images are given as the input and we will be knowing whether tumor exists or not in the MRI Image. We have also built a website whether the user gives a image then he can able to know whether the tumor exists or not.

3. Keywords

CNN – Convolutional Neural Networks

VGG19 – A type of CNN algorithm

Mobile Net – A type of CNN algorithm

Introduction

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.

For the purpose of detecting the tumour to measure Image processing Techniques are used. In this we are also using neural networks to do the methodology. We can analyse the image of Brain Tumour by using computer image processing technology and extract the features of MRI Image and spot according to colour, texture and other characteristics from a quantitative point of view. An automatic detection of the Tumour by simply seeing the MRI Image is simply flexible. A convolutional neural network (CNN) is a type artificial Neural Network used in image recognition and processing that is specifically designed to process pixel data. CNNs are powerful image processing, artificial intelligence (AI) that use deep learning to perform both generative and descriptive tasks, often using machine vison that includes image and video recognition. A CNN uses a system much like a multilayer perceptron that has been designed for reduced processing requirements. The layers of a CNN consist of an input layer, an output layer and a hidden layer that includes multiple convolutional layers, pooling layers, fully connected layers and normalization layers. Transfer learning is a technique where a deep learning model trained on a large dataset is used to perform similar tasks on another dataset. In this project We are using Transfer Learning Models like VGG19 and Mobile Net Model.

Literature Review

For this project we have studied some Research Papers:

1. Automatic Brain Tumor Detection and Segmentation Using U-Net Based Fully Convolutional Networks. https://arxiv.org/abs/1705.03820

In this paper they have proposed a U-Net Convolutional Networks for detecting the Brain Tumor. Their method was evaluated on Multimodal Brain Tumor Image Segmentation (BRATS 2015) datasets, which contain 220 high-grade brain tumor and 54 low-grade tumor cases.

2. A Review Paper on Brain Tumor Segmentation and Detection https://www.researchgate.net/publication/317547838_A_Review_Paper_on_Brain_Tumor_Segmentation_and_Detection

In this Paper they have proposed detection of brain tumor is to check the symmetric and asymmetric Shape of brain which will define the abnormality. After this step their next step is segmentation which is based on two techniques

1) F-Transform (Fuzzy Transform) 2) Morphological operation.

Methodology

Application Development

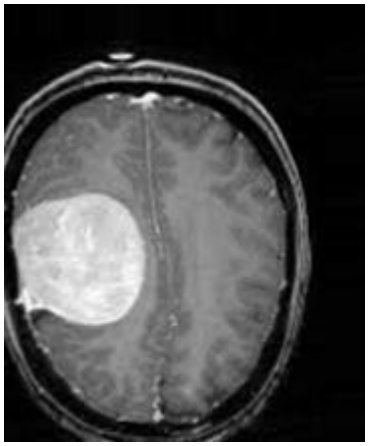
The web application for the agriculture was developed using the Jupiter notebook. Jupiter notebook is the official Integrated Development Environment (IDE) for web platform development. The development of the website had various stages such as creation of server, training images in the dataset, accessing images from dataset, updating information into the dataset and extracting message from the dataset. The procedure first was started by creating a server by creating account in anaconda navigator and a dataset and consequently a website for uploading images should create. Later a python was written for connecting to the server and the dataset to the web application.

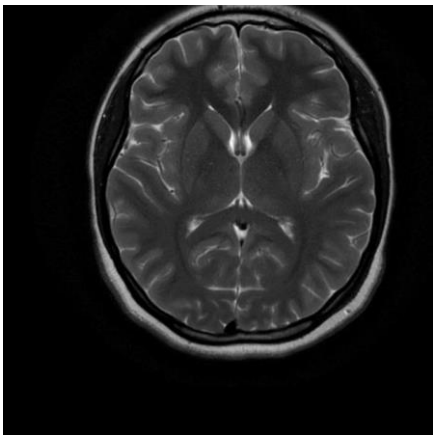
Data Collection

We have collected our Dataset from Kaggle Website. The dataset contains 2 folders: yes (Which represents Brain tumour affected Images) and no (Which represents Non-Tumour Images) which contains 3000 Brain MRI Images. The folder yes contains 2500 Brain MRI Images that are tumorous and the folder no contains 500 Brain MRI Images that are non-tumorous.

Sample Images from Datasets:

Tumour Image Non-Tumour Image





Data Augmentation:

Since there are less images for non-tumorous images, there wasn't enough examples to train the neural network. For this Issue we are applying Data Augmentation to increase the number of images. Also, data augmentation was useful in tackling the data imbalance issue in the data.

Before data augmentation, the dataset consisted of:
2500 Yes and 500 No Images, resulting in 3000 example images.

After data augmentation, now the dataset consists of:
2500 Yes and 2500 No Images, resulting in 5000 example images.

Creating the model:

Creating the model from the data set in the process involved in the ml-based learning. First, import the libraries and then import the dataset by giving the path and then we should train the data that is we have to trained the images by generating the images using image data generator by using this we can resize the images then we will train all the images by adjusting the height and weight of the images. And then we will create the predictions on it by using the algorithms vgg19, mobile net and the CNN algorithm which we have built. After Building the model and afterwards we test with testing Data and able to know accuracy of the model and draw the curves validation loss (Vs) Validation Loss and Training Accuracy (Vs) Validation Accuracy.

Upload Image:

When the user opens the website so that the user can select image his MRI Image. On selection of the picture, he can able to know whether the Tumour is Present OR not.

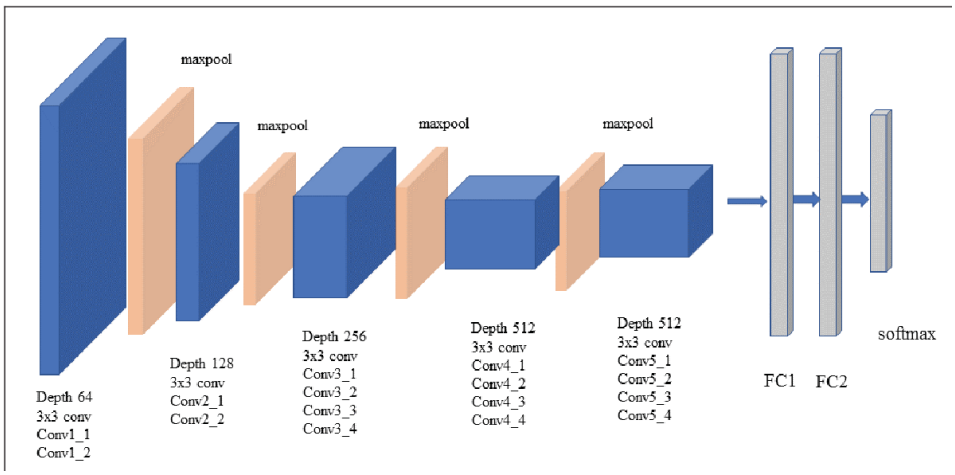
Algorithm:

There are many algorithms which can be used to identify the brain tumour, in our project we used vgg19, mobile net algorithms.

VGG19 CNN algorithm:

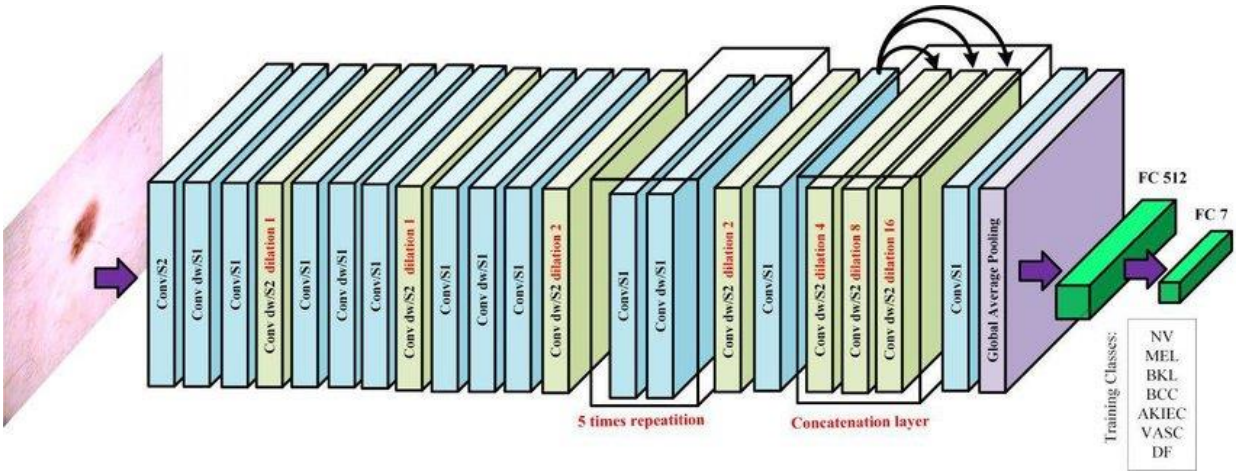
VGG19 is a pretrained convolutional neural network model achieved a 92.7%accuracy in ImageNet, which is a dataset of over 14 million images belonging to 1000 classes.

Architecture:



Mobile net CNN algorithm:

Mobile Net uses depth wise separable convolutions. It significantly reduces the number of parameters when compared to the network with regular convolutions with the same depth in the nets.



Normal CNN algorithm:

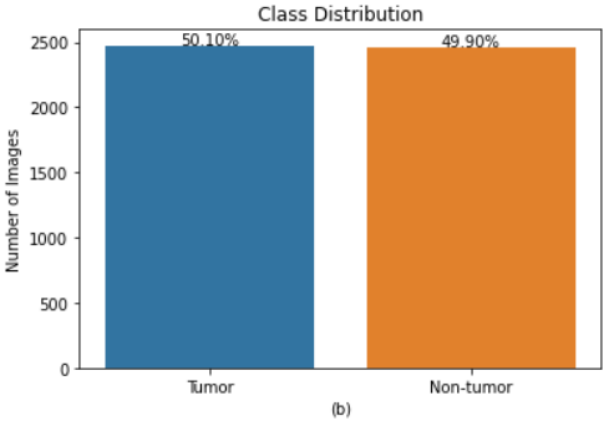
This is the model which we have built with the four set of convolutional Network and Maxpooling layer.

Architecture:

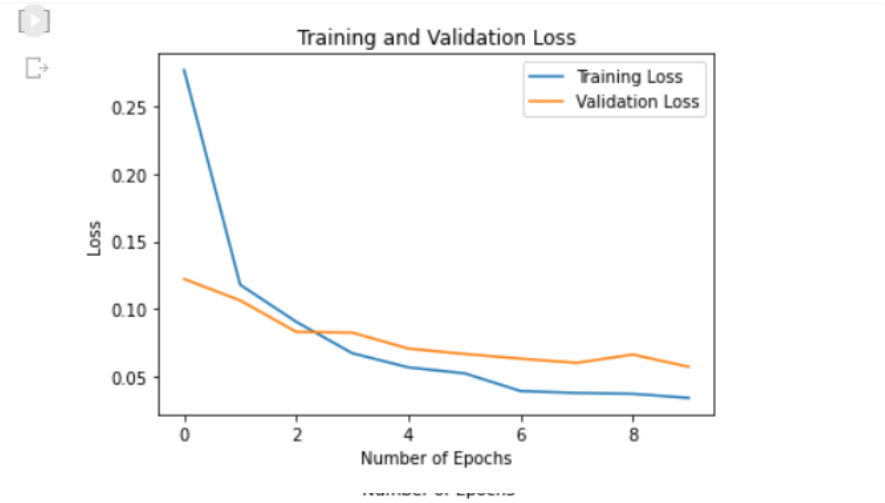
Layer (type)	Output Shape	Param #
sequential (Sequential)	(64, 256, 256, 3)	0
conv2d (Conv2D)	(64, 254, 254, 32)	896
max_pooling2d (MaxPooling2D)	(64, 127, 127, 32)	0
conv2d_1 (Conv2D)	(64, 125, 125, 64)	18496
max_pooling2d_1 (MaxPooling 2D)	(64, 62, 62, 64)	0
conv2d_2 (Conv2D)	(64, 60, 60, 64)	36928
max_pooling2d_2 (MaxPooling 2D)	(64, 30, 30, 64)	0
conv2d_3 (Conv2D)	(64, 28, 28, 64)	36928
max_pooling2d_3 (MaxPooling 2D)	(64, 14, 14, 64)	0
conv2d_4 (Conv2D)	(64, 12, 12, 64)	36928
max_pooling2d_4 (MaxPooling 2D)	(64, 6, 6, 64)	0
flatten (Flatten)	(64, 2304)	0
dense (Dense)	(64, 64)	147520
dense_1 (Dense)	(64, 2)	130

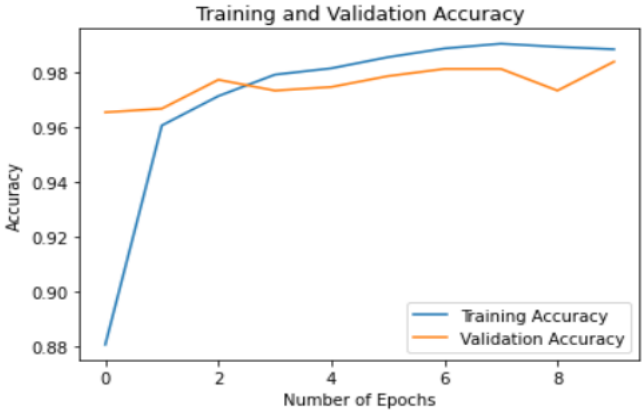
Implementation Results:

1. VGG19 Algorithm:



Above Bar Graph represents the distribution of tumor images present in the dataset.

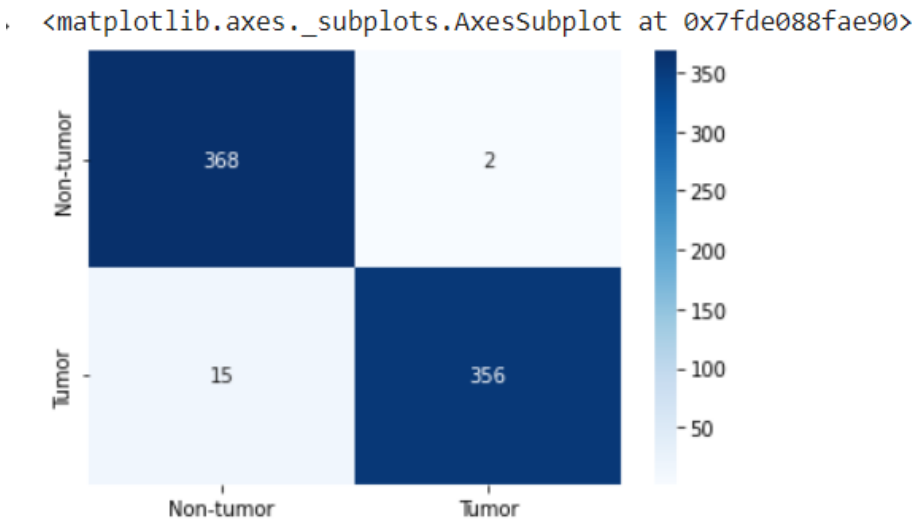




Above Two Curves represent the Training and validation loss and the second one represents the training and validation accuracy.

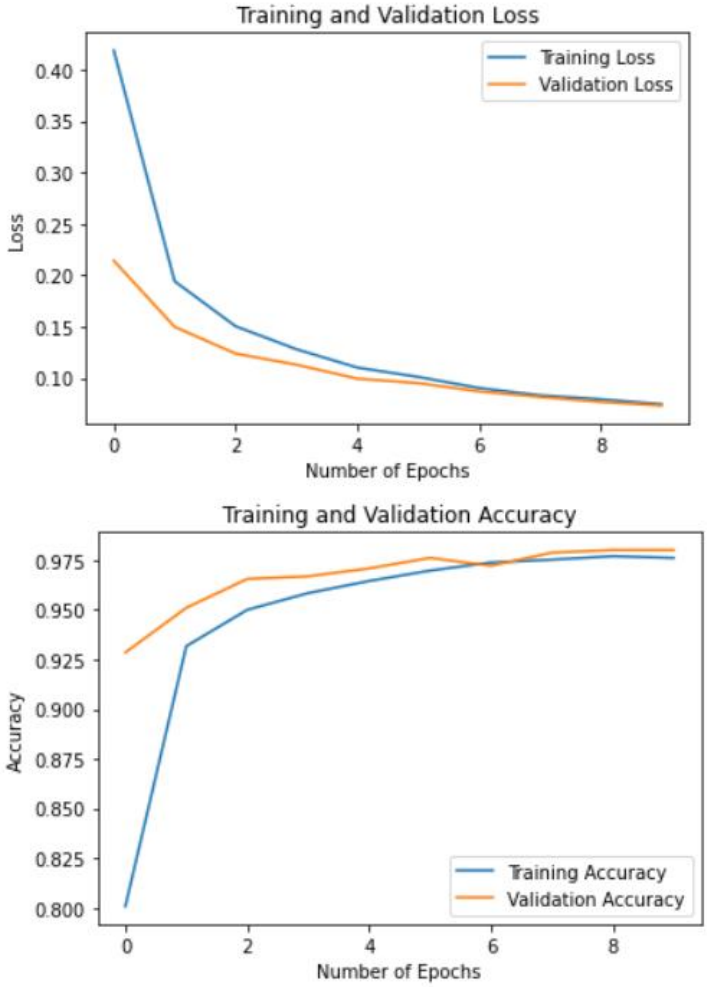
```
Accuracy: 0.977058
Precision: 0.994413
Recall: 0.959569
F1 score: 0.976680
Cohens kappa: 0.954118
ROC AUC: 0.977082
[[368   2]
 [ 15 356]]
Specificity:  0.9945945945945946
              precision    recall  f1-score   support

           0       0.96      0.99      0.98       370
           1       0.99      0.96      0.98       371

    accuracy                           0.98       741
   macro avg       0.98      0.98      0.98       741
weighted avg       0.98      0.98      0.98       741
```

The above image shows about the Accuracy , Precision , Recall , etc of our model.



The above one is confusion matrix and out of 370 Non tumor Images our model is Predicting 368 correct and 2 wrong and out of 370 tumor images our model correctly Classifies 356 images which is good.

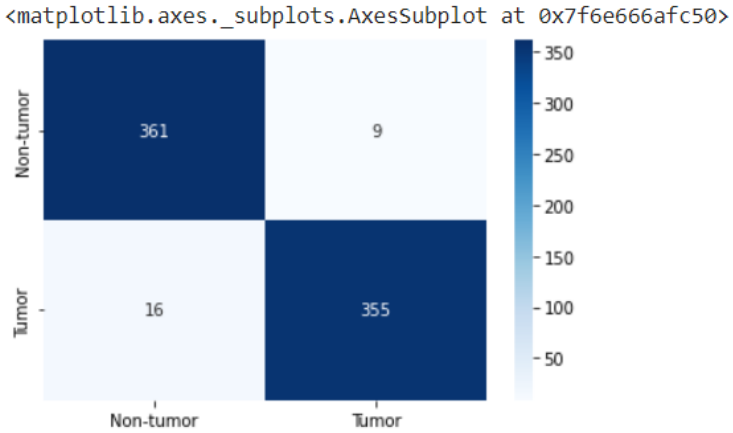
2. Mobile Net Algorithm:



Above Two Curves represent the Training and validation loss and the second one represents the training and validation accuracy.

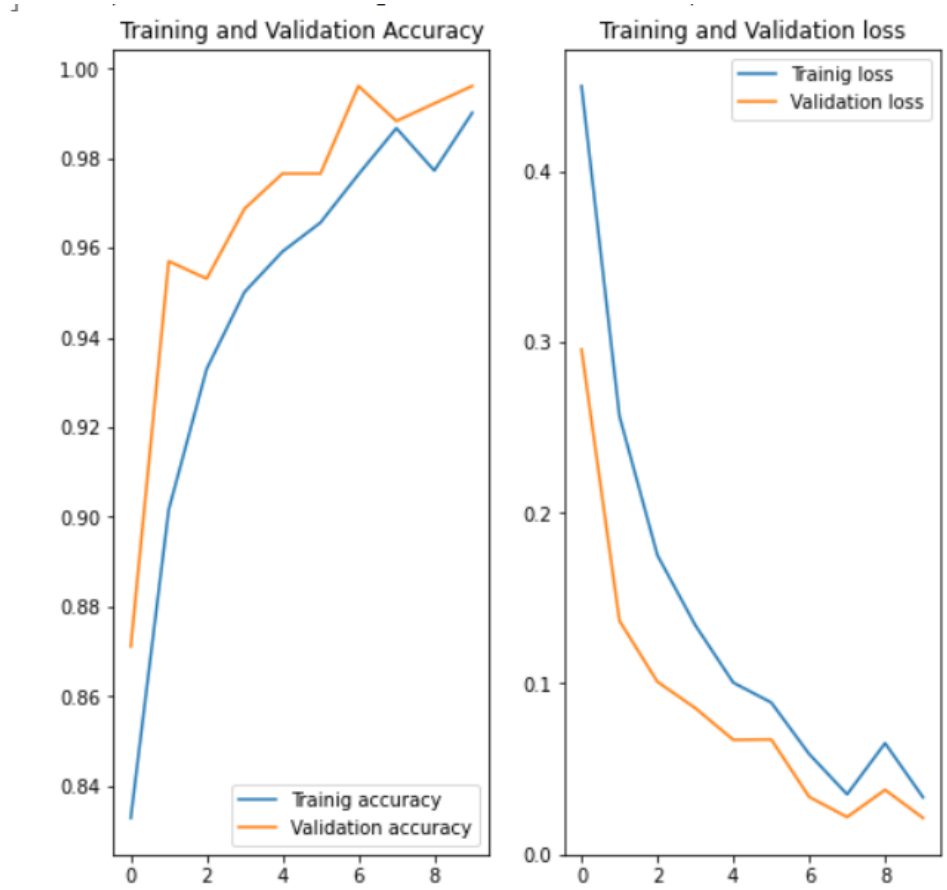
```
Accuracy: 0.966262
Precision: 0.975275
Recall: 0.956873
F1 score: 0.965986
Cohens kappa: 0.932525
ROC AUC: 0.966274
[[361   9]
 [ 16 355]]
Specificity:  0.9756756756756757
              precision    recall  f1-score   support

           0       0.96      0.98      0.97       370
           1       0.98      0.96      0.97       371

    accuracy                           0.97       741
   macro avg       0.97      0.97      0.97       741
weighted avg       0.97      0.97      0.97       741
```

The above image shows about the Accuracy, Precision, Recall, etc. of our model.



The above one is confusion matrix and out of 370 Non tumor Images our model is Predicting 361 correct and 9 wrong and out of 370 tumor images our model correctly Classifies 355 images which is good.

3.Normal CNN Algorithm:

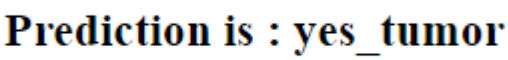


Above Two Curves represent the Training and validation loss and the second one represents the training and validation accuracy.

```
[ ]  model.evaluate(test_ds)

    6/6 [==============================] - 8s 80ms/step - loss: 0.0677 - accuracy: 0.9870
    [0.06767229735851288, 0.9869791865348816]
```

The above image shows the accuracy and loss of our model on the test dataset.

Here the user uploads a image in the website and it gives the prediction.



Conclusion:

We have successfully deployed a server where the user can upload the MRI Image of the Brain and here, we successfully predicted whether the tumor is present or not