Project Report

On

Brain Tumor Detection Using CNN

A Project Report submitted in partial fulfilment of the requirements

for the award of the degree of

Bachelor of Technology
In
Computer Science and Engineering

by

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Declaration

We hereby declare that the work which is being presented in the B.Tech. Project **"Brain Tumor Detection"**, in partial fulfillment of the requirements for the award of the **Bachelor of Technology** in Computer Science and Engineering and submitted to the Department of Computer Engineering and Applications of GLA University, Mathura, is an authentic record of our own work carried under the supervision of **Dr. Hitendra Garg.** The contents of this project report, in full or in parts, have not been submitted to any other Institute or University for the award of any degree.

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Certificate

This is to certify that the above statements made by the candidates are correct to the best of our knowledge and belief.

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Abstract

A tumor is defined as a lump that grows abnormally without any control. In most of the cases the tumor is dangerous. At an early stage, a brain tumor can be a tough task even for doctors to figure out. Using MRI Images is not always reliable, because MRI images contain noise and other disturbances, so hence it becomes difficult for doctors to identify tumor and their causes. So, this is where Image Processing comes, few of its techniques are used to recognize the image of interest in order to visualize the images easily. We propose a system which detects tumor from brain MRI images. First, we do processing of the image by converting the given image into a grey scale image and some filters are applied like bilateral or gaussian or median filter to filter noise and other disturbances from the image and find out contours of the image, then we construct the CNN layers and perform binary classification using Convolutional neural network.

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Chapter:1 Introduction

1.1 Overview and motivation:

The human body is composed of many types of cells. Each cell has a specific function. The cells in the body grow and divide in an orderly manner and form some new cells. These new cells help to keep the human body healthy and properly working. When some cells lose their capability to control their growth, they grow without any order. The extra cells formed form a mass of tissue which is called tumor. These tumors can be benign or malignant. Malignant tumors lead to cancer while benign tumors are not cancerous. Brain tumor occurred when the cells were dividing and growing abnormally. It is appearing to be a solid mass when it diagnosed with diagnostic medical imaging techniques. There are two types of brain tumor which is primary brain tumor and metastatic brain tumor. Primary brain tumor is the condition when the tumor is formed in the brain and tended to stay there while the metastatic brain tumor is the tumor that is formed elsewhere in the body and spread through the brain.

The symptom having of brain tumor depends on the size, location and type of the tumor. It occurs when the tumor compressing the surrounding cells and gives out pressure. Besides, it is also occurring when the tumor blocks the fluid that flows throughout the brain. The common symptoms are having headache, nausea and vomiting, and having problem in balancing and walking.

With the improvement of modern medical standards, medical imaging technology plays an increasingly important role in daily medical diagnosis and medical research. Therefore, research on medical diagnostic image data is very important. As a tumor disease with frequent occurrence and complexity, brain tumor has become a key research topic in the medical field. The diagnosis of brain tumors is usually based on imaging data analysis of brain tumor images. Accurate analysis of brain tumor images is a key step in determining a patient's condition. However, the accumulation of doctorspersonal medical knowledge, differences in experience levels, and visual fatigue can affect the correct analysis of image results.

Therefore, how to accurately detect brain tumor images is very important and this is the reason which motivate us to work on them.

1.2 Objective:

In this project, we were asked to experiment with a real-world dataset of brain tumor, and to explore how deep learning algorithms can be used to detect the imageconsist tumor in the dataset. We were expected to gain experience using deep learning algorithms and various libraries are used for data visualization, transformation etc.

So, our main objective of this project is to classify the tumor or non-tumor images using deep learning algorithms. To gain the main objective of this project we had done many smaller objectives like augmentation, cropping, visualization, transforming and many more.

Chapter 2: Software Requirement Analysis

2.1 About Dataset:

The basic requirements of an ML algorithm is dataset, training of that dataset using the algorithm and testing the model. So, we have used the dataset from Kaggle. Our dataset has two folders:

- Yes – It consists of 1000 images
- No – It consists of 1000 images

The link for the dataset that we have collected from Kaggle is given below:
https://www.kaggle.com/ahmedhamada0/brain-tumor-detection

2.2 Requirements analysis:

Hardware Requirements Specification:

- Intel Pentium III Processor or above
- GB RAM
- 20 GB HDD
- Keyboard and Mouse

Software Requirements Specification:

- Technologies: Python 3 and Deep Learning
- Libraries: Numpy, Matplotlib, Ploty, Pandas, Sklearn, Keras
- Platform: Google Colaboratory
- Operating System: Windows 7, 8, 9, 10

Chapter 3: Proposed Methodology

In this project we have detect the whether an MRI image contain brain tumor or not. For this we have used the image dataset. This will be done in many phases. After importing dataset, we have converted image into grey scale image and blur it slightly. Some filters are applied to filter noise and other disturbances from the image and find out contours of the image and afterwards, we crop the image. The images are split into training,testing,validation dataset. We plot the bar graph for better visulaization of dataset distribution. After this we have done the zero padding to maintain the dimensions of image to after filtering. Then we have done the argumentation of images to get the more images for better results.

Then we construct the CNN layers and perform classification. This is a binary class classification as the output is 0 or 1, which means normal or tumor.

3.1 About CNN:

CNN stands for convolutional neural network. Convolution Neural Network is an algorithm that is used in our project,for the identification of 2D image and to get information from it. It has mainly has the following layers: input layer, zero padding layer,convolution layer, max pooling layer, and fully connected layer. It require less preprocessing as compare to other image classification algorithm.

3.1.1 Input layer:

Input layer should contain image dataset. Image is represented by three cross three matrix. You need to reshape into single column.

3.1.2 Zero padding layer:

This layer can add rows and columns of zeros at the top, bottom, left and right side of an image tensor.

3.1.3 Convolution layer:

A convolutional layer contains a set of filters whose parameters need to be learned. The height, width of the image volume is greater than the image filter. Filter slides across the width and height of the input. Dot product between input and filter is calculated at the spatial position. The output volume of the convolutional layer is obtained by stacking the activation maps of all filters along the depth dimension. Since the width and height of each filter is designed to be smaller than the input, each neuron in the activation map is only connected to a small local region of the input volume.

3.1.4 Pooling Layers:

This layer is usually incooperated between two successive convolutional layer. Pooling layers are used to reduce the dimensions of the feature maps. Thus, it reduces the number of parameters to learn and the amount of computation performed in the network. It summarizes the feature present in the region of the feature map which is generated by convolutional layer. Due to this further operations are performed on summarized features instead of precisely positioned features generated by the convolution layer. By this model become robust to variation in the position of the features in the input images. Max pooling is one type of pooling layer.

3.1.5 Max pooling layer:

Max pooling is a pooling operation that selects the maximum element from the region of the feature map covered by the filter. Thus, the output after max-pooling layer would be a feature map containing the most prominent features of the previous feature map.

3.1.6 Fully connected layer:

This layer is the essential component of Convolutional Neural Networks (CNNs), which have been proven very successful in recognizing and classifying images for computer vision. The Convolutional neural network process begins with convolution and pooling, breaking down the image into features, and analyzing them independently. The result of this process feeds into a fully connected neural network structure that drives the final classification decision.

3.2 Implementation:

The performance of deep learning neural networks often improves with the amount of In this study, we have use Brain Tumor Dataset that consists of brain MRI images from kaggle. This dataset has 3000 images that has been divided into two separate equal groups first 1500 images have brain tumors and other 1500 images do not have brain tumor.

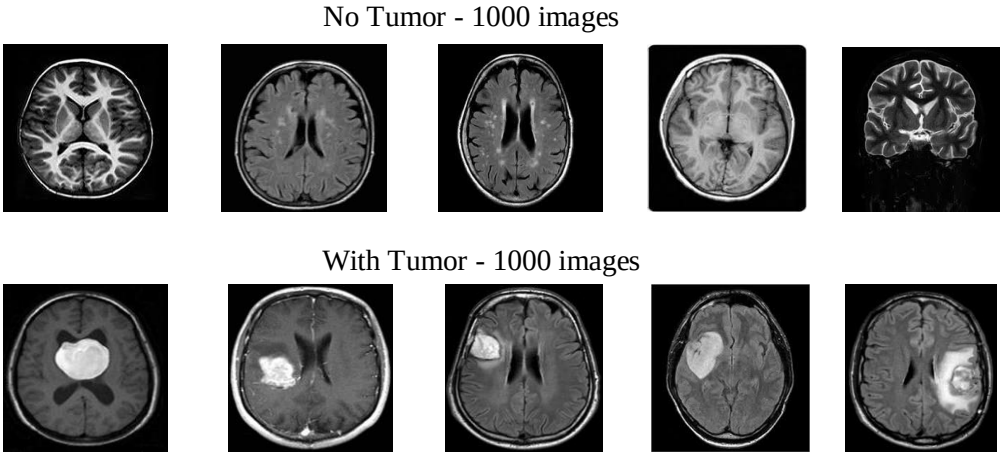

Figure 3.1: Image Dataset

3.2.1 Filters:

It refers to making the image less clear or distinct. It is done with the help of various low pass filter kernels. There are a lot of filter such as Gaussian filter, median filter and bilateral filter. Now we have taken images from newly made dataset and convert into grey scaled images and remove blurredness from images using bilateral filter. Then we perform set of erosions and dilations to remove all small areas of noise by using thresholding.

3.2.2 Contour:

It is very useful to calculate the effective area in the image. After that, we have grabbed the largest contour using imutils.grab_contours() and max() function respectively as shown in given figure.

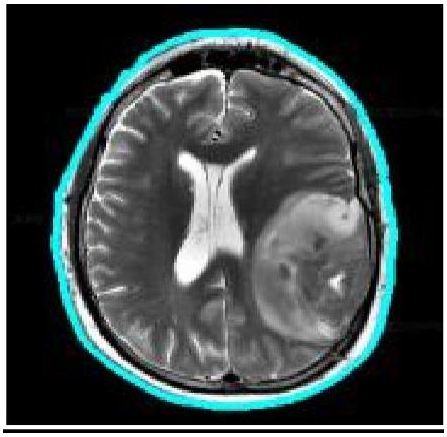

Figure 3.2: The largest contour

3.2.3 Cropping:

It is the processing in which we will remove the extra part of image by calculating extreme points in the image. That's why, we have calculated four extreme points (left extreme, right extreme, top extreme and, bottom extreme point) to crop the images. After cropping the image will look like as image shown in given figure.

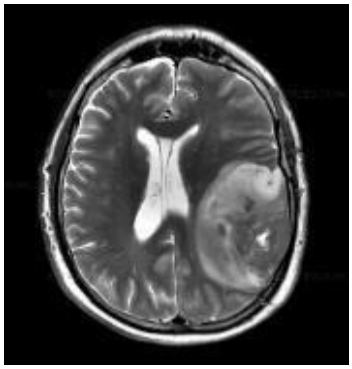

Fig 3.3.a: Original image

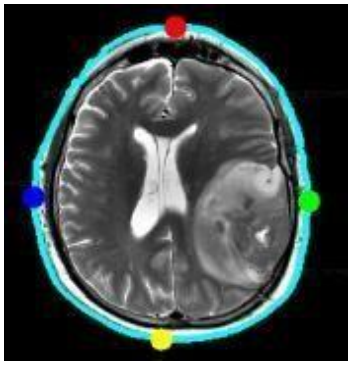

Fig 3.3.b: Extreme points

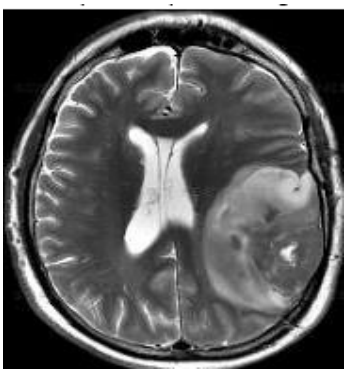

Fig 3.3.c: Cropped image

3.2.4 Resizing of image:

Sometimes, it is necessary to increase the size of the image to perform the detection operation easily. So, we use cv2.resize() function provided by OpenCV to resize the image.

3.2.5 Visualization of images:

Since, we need a visual summary of information which makes it easier to identify patterns and trends. For that purpose, we have used imshow() function of matplotlib library which is used to display the images.

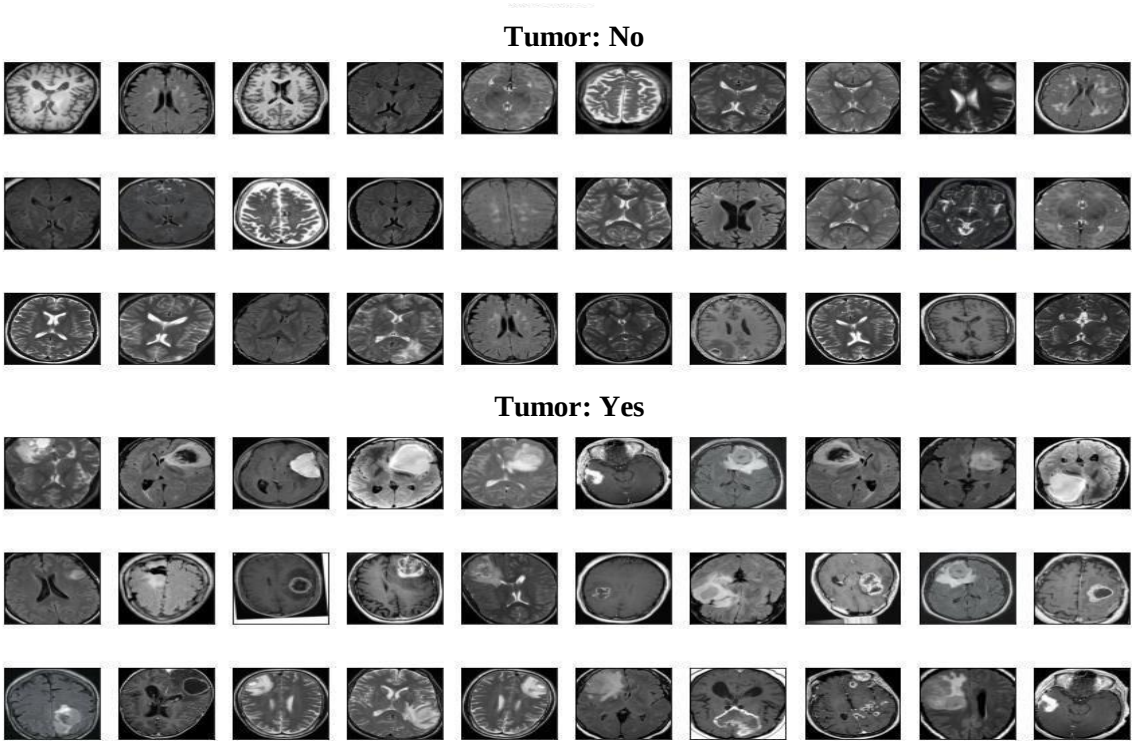

Figure 3.4: Image Visualization

We have also used iplot() function to get interactive plots and used to display the no of classes in the training and testing datasets.

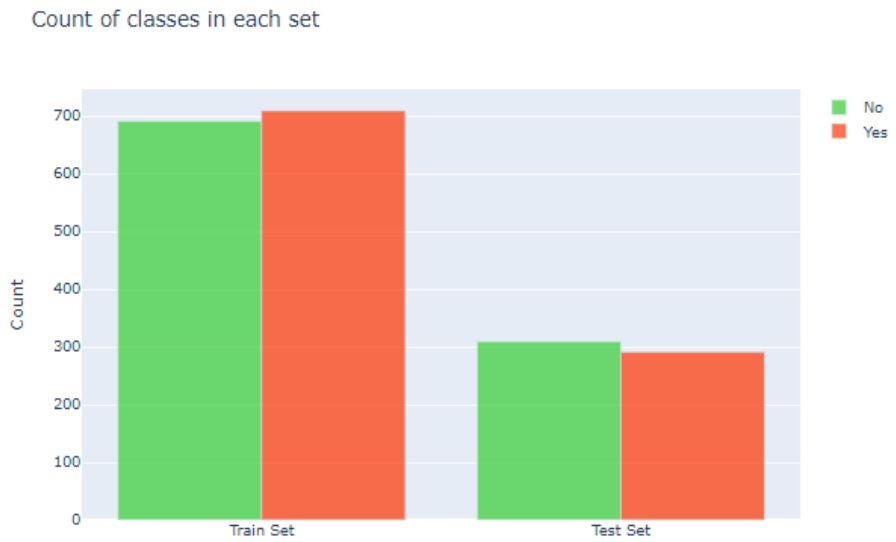

Figure 3.5: No of classes

3.2.6 Building of model:

We have used Convolution Neural Network to build the deep learning model for image analysis, pattern detection and classification problems as well. It has various layers such as Convolution layer, Pooling Layer and Fully connected layer.

Convolution layer receives the input from input layer and output the transformed input to the next layer. We specify the filters along with the layers to detect the patterns . These filters are matrix of small size and filters will slide over each set of pixels of image until entire image is covered. This sliding process is called as convolving and then dot product of the filter with each block of pixels of image from the input is computed. In this way, features are extracted from the image and reduce the dimensions of the array containing the pixels values of the image.

Then the ReLU activation function is applied in the hidden layers. This function returns 0 if it receives any negative input, but for any positive value x, it returns that value back. Mathematically, it is represented as-

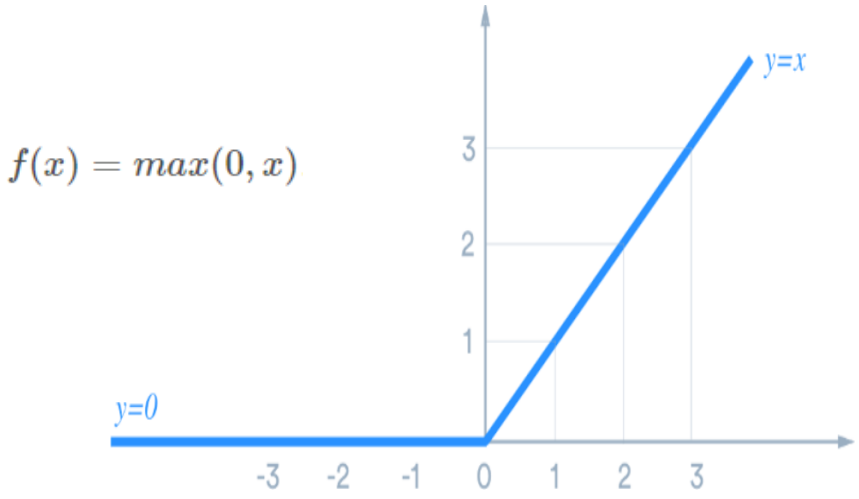

Figure 3.6: ReLU Activation Function

Now, pooling layers are used to reduce the dimensions of the featured maps generated by the convolution layer and this layer containing the most prominent features of the previous feature map and it returns an array with the same depth as the convolution layer.

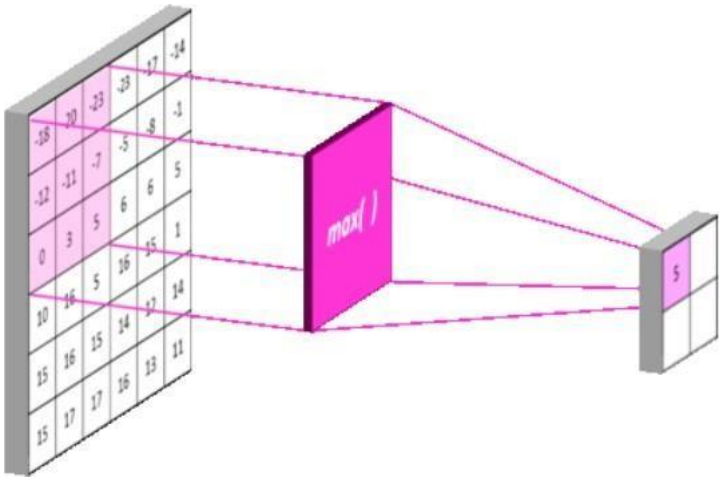

Figure 3.7: Max-pooling is shown here along with the filter and stride

Stride is a parameter of the neural network's filter that modifies the amount of movement over the image. For example, if a neural network's stride is set to 1, the filter will move one pixel, or unit, at a time, which is shown below:

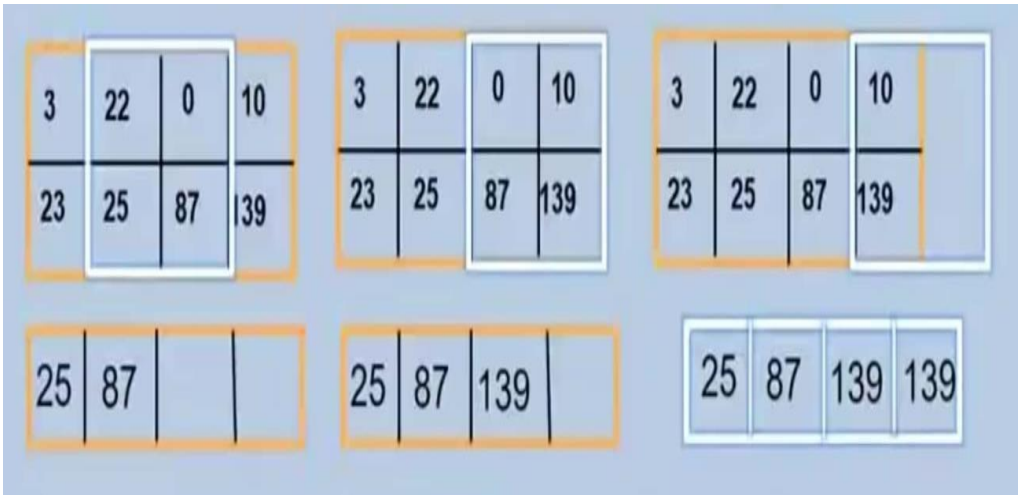

Figure 3.8: Stride over the image

Now, flattening is applied to convert the pooled featured map into a 1-d array and inserted to the final classification model, which is called a fully-connected layer. This layer combines all the features together to insert into the model so that it will classify the image into a well defined label.

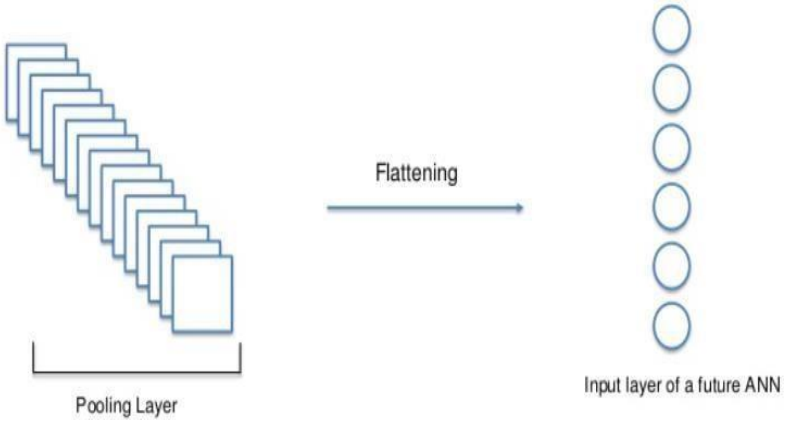

Figure 3.9: Flattening process

Then the flattened array obtained after the flattening process will be passed to fully-connected neural network.

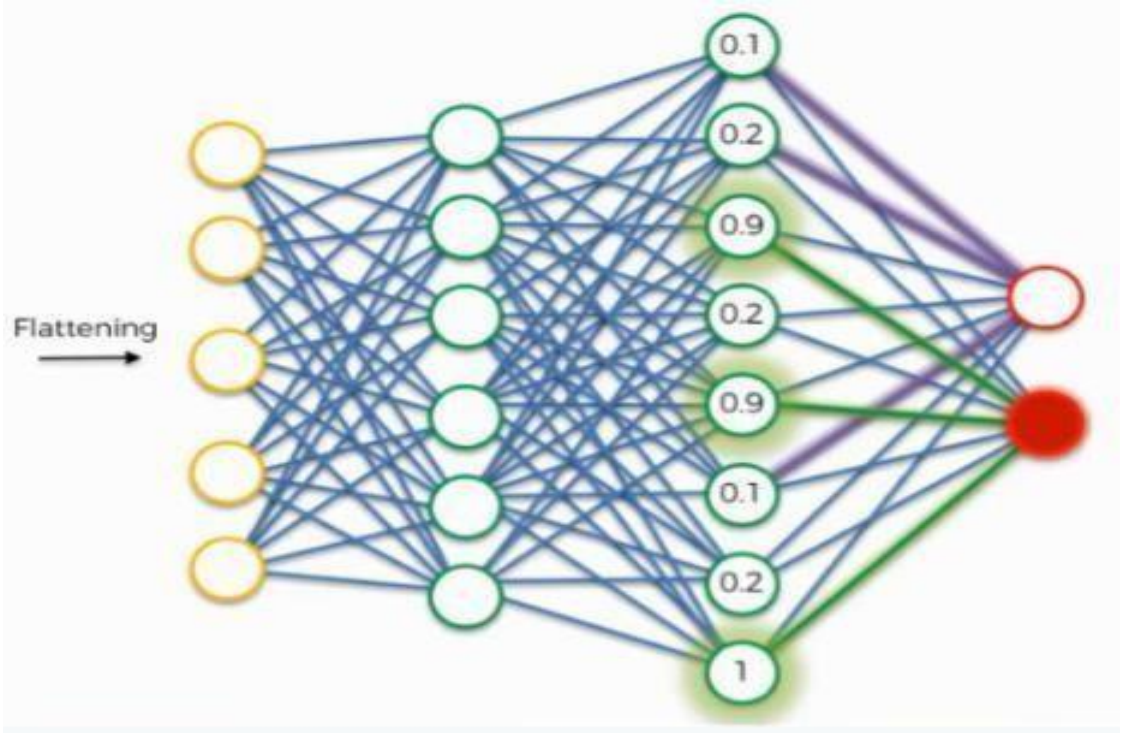

Figure 3.10: Fully Connected Layers in the network

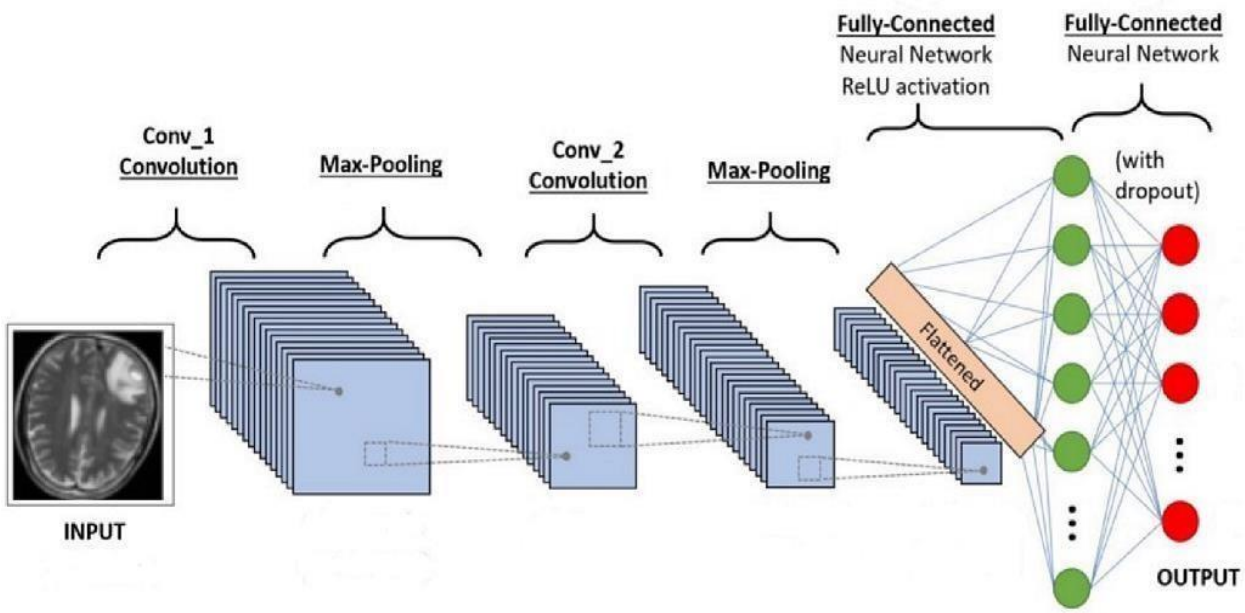

Figure 3.11: Complete CNN architecture with various layers

3.2.7 Accuracy of the model:

Accuracy is evaluating the performance of the model by finding that how much the predicted results by the model are correct in compare to real data. For that purpose, we have used plot_metrics() and confusion metric to get accuracy.

Some results of the model are shown below:

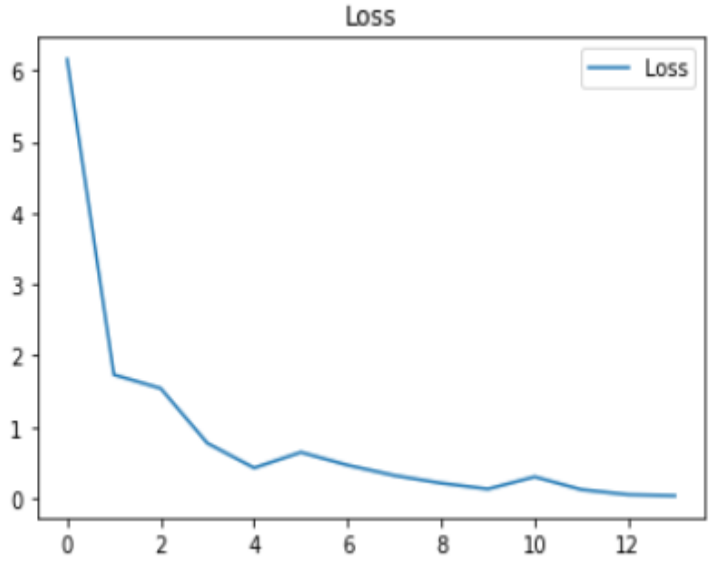

Figure 3.12: Loss

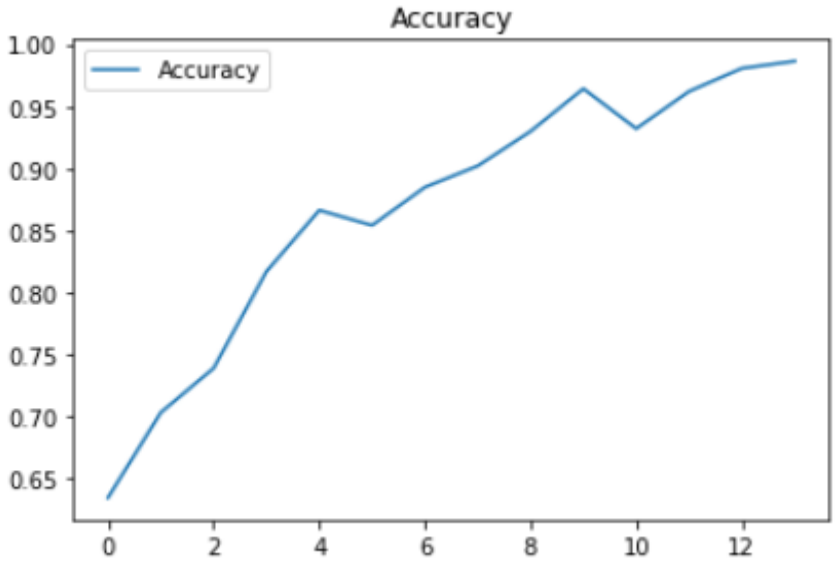

Figure 3.13: Accuracy

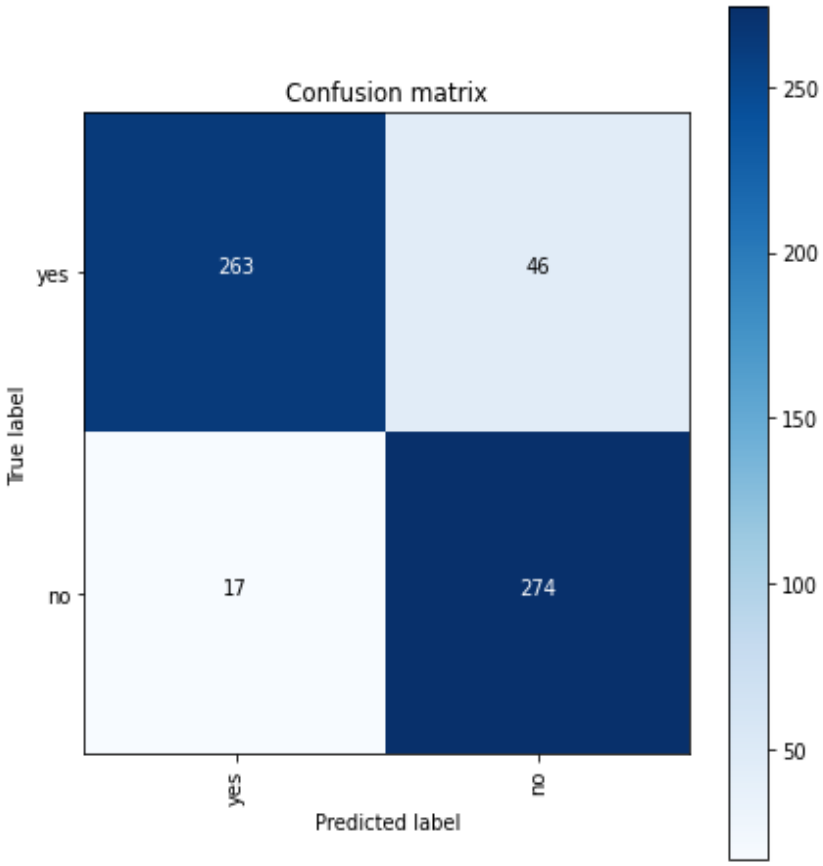

Figure 3.14: Confusion Matrix

3.3 Result Analysis:

As a result, we got an accuracy of 96% through binary classification and our model predicts the images as shown below:

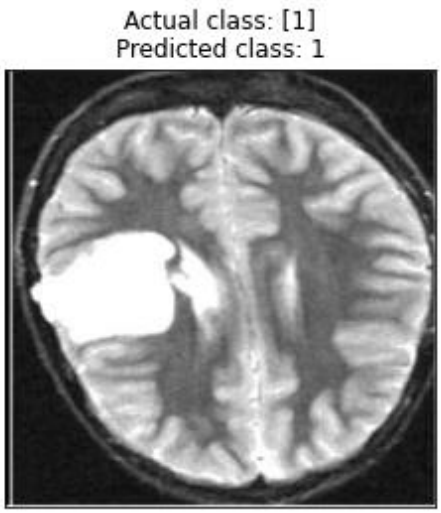

Figure 3.15

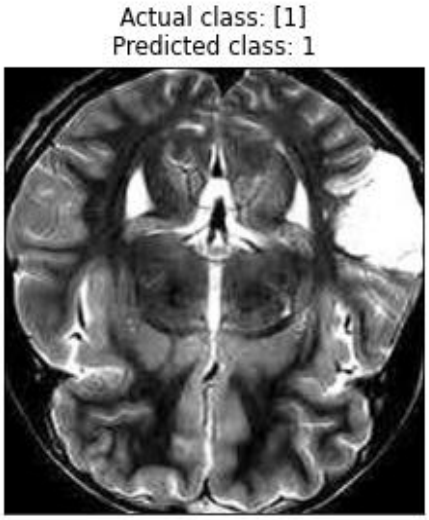

Figure 3.16

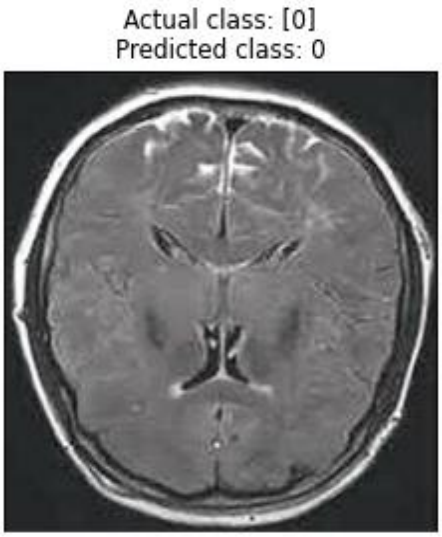

Figure 3.17

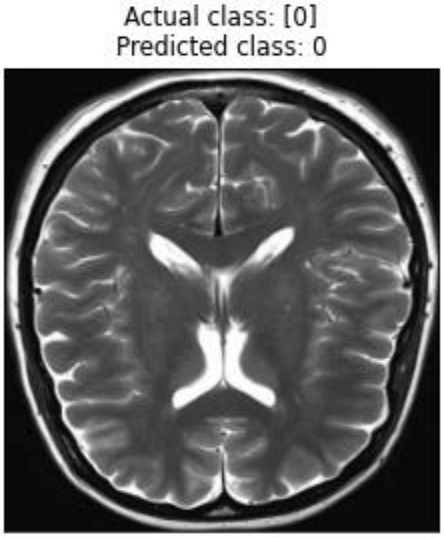

Figure 3.18

Chapter 4: Conclusion

Brain tumor is the dangerous and life-threatening problem and hampers the normal functioning of the human body. For proper diagnosis and efficient treatment planning, it is necessary to detect the brain tumor in early stages. So, this is where Image Processing comes, few of its techniques are used to recognize the image of interest in order to visualize the images easily. We propose a system which detects tumor from brain MRI images. First, we do the processing of the image then find out contours of the image, then we construct the CNN layers like input layer, convolution layer, polling layer and fully connected layer. The main objective behind this project is to review an idea of detection of brain tumor from the MRI image which is taken as an input and can classify whether the given is having a tumor or not by using Convolutional Neural Network. Experimental results classify whether MRI image contain brain tumor or not, with an accuracy of 96% through binary classification.

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