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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/15072
DOI URL: http://dx.doi.org/10.21474/IJAR01/15072

*RESEARCH ARTICLE*

# DEEP LEARNING-BASED BRAIN TUMOR DETECTION

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## *Manuscript Info*

***Manuscript History***
Received: 24 May 2022
Final Accepted: 28 June 2022
Published: July 2022

## *Abstract*

A group of aberrant brain cells is known as a brain tumor. Brain tumors can be either malignant or benign. Whereas benign is not cancerous, malignant is. Both tumors are extremely dangerous because they spread quickly and affect many areas of the brain. About 166,039 people in the US had brain tumors or other cancers of the central nervous system in 2015.Even afterseveral researches,the cause of braintumorisunknown. We aimed to detect the brain tumor through image processing usingimages of MRI scans. Using Convolutional Neural Network(CNN) to perform imagebased classification. On receiving the image from the MRI scan as input, CNN will assess if the person has a brain tumor or not.It is observed on experimentation that the proposed approach needs an input image of size of240*240. Any image of another size cannot be used and the input image should only be a grayscale image. Color image cannot be used as an input image. The model which we proposed canbe further improved by using any size image as input. Moreover, the accuracy which we gotthrough this CNN model is 0.88. The model can be further improved by some changes so thataccuracy can be increased further.



## Introduction:-

The brain tumor is said to be one of the deadliest diseases to humans. The abnormal cellsin the body may or may not spread rapidly depending upon the location of tumor and itspredicted growth rate. The treatment needs to be started as soon as possible. The aim ofthis project is to detect brain tumor provided that the MRI Scan images are available. Itwill be done using Convolutional Neural Network (CNN) model as it provides featureextraction for images and image classification tasks. The model will be able to classifybasedonimageswhetherornotthepersonhas braintumor.

The first chapter deals with the insights of the project that is a short description of theproblem. The second chapter, Literature Review, describes the algorithms and methodsthatwehavestudiedbeforecomingtoouralgorithm.ThethirdchapterisProjectDescription. It describes our flow of work throughout the project and our proposed model.It also describes each layer of the model. The fourth chapter shows our model evaluationresults and predictions. The final chapter concludes and talks about the future scope of ourproject.

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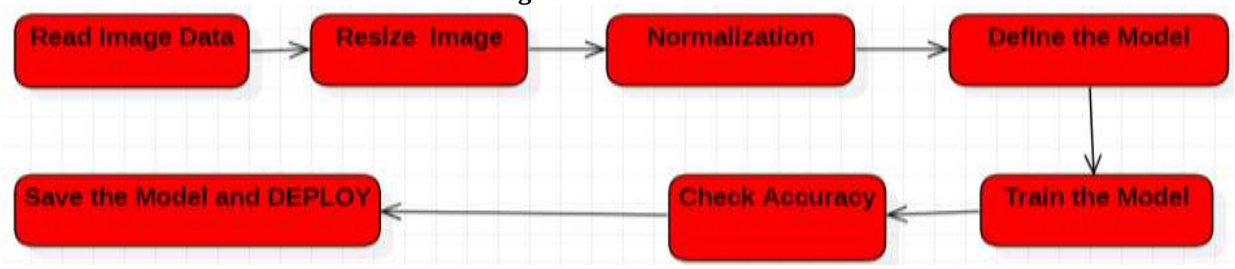
Using a computer to edit a digital image is known as an image processing technique. This method has a lot of advantages, including flexibility, adaptability, data storage, and communication. The development of numerous image scaling algorithms has made it possible to maintain photos effectively. Numerous sets of criteria must be applied concurrently in the photos while using this technique. Multiple dimensions can be handled for the 2D and 3D photos.

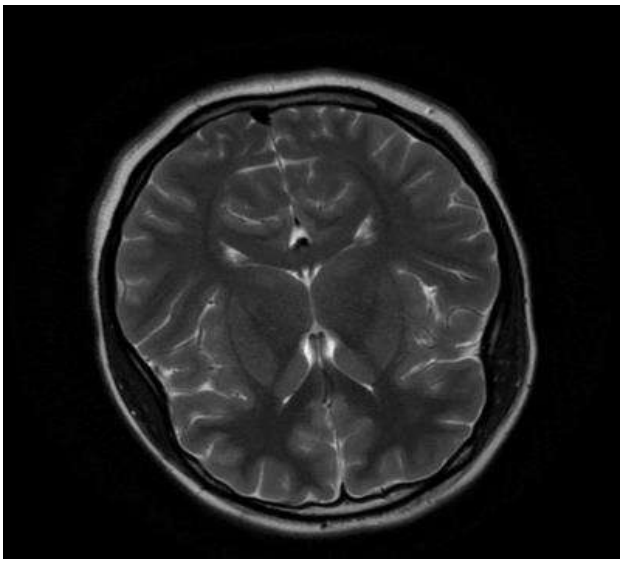
Cells start dividing and expanding in an improper way, which results in brain tumor. When it is identified using imaging tools for medical diagnosis, it seems to be a solid mass. Primary and metastatic brain tumors are the two forms of brain tumors. In contrast to metastatic brain tumors, which originate elsewhere in the body and spread to the brain, primary brain tumors are those that develop in the brain and are more likely to remainthere.

**ProblemStatement:**
Brain is an organ that controls activities of all the parts of the body. Recognition ofautomated brain tumor in Magnetic resonance imaging (MRI) is a difficult task due tocomplexity of size and location variability. To provide better treatment for the sufferings.The abnormal growth of cells are called tumors and cancer is the term used to representmalignanttumors.usuallyCTorMRIareusedfordetectingtumors.Hereourdeeplearningmodel is used to diagnose the brain tumor by taking the images of MRI .we are using theconvolutionalneuralnetworkandPredictionwillshownas braintumoristhere.

**Figure-1:-** FlowChart.




**Datasetandattributes:**
ForthisprojectdatasetwascollectedfromKagglewebsite.ItconsistsofBraintumorimages.The dataset has 2065 MRI images in which tumor images are 1085 and other no tumor 980images.



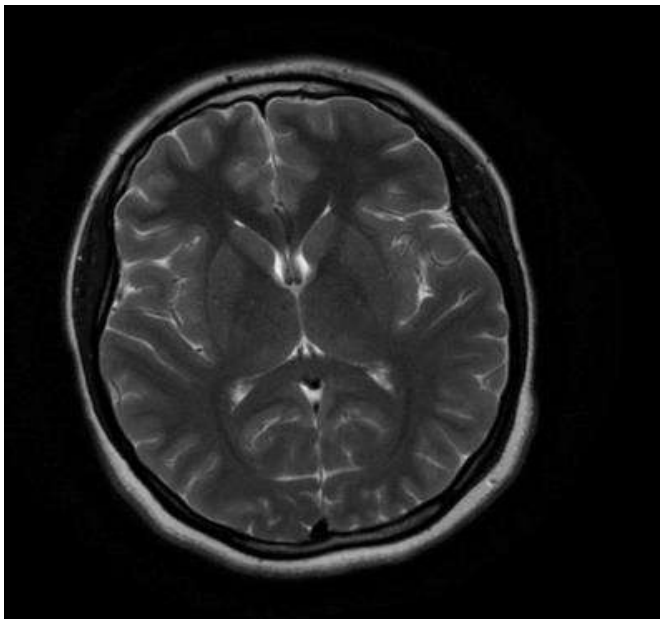
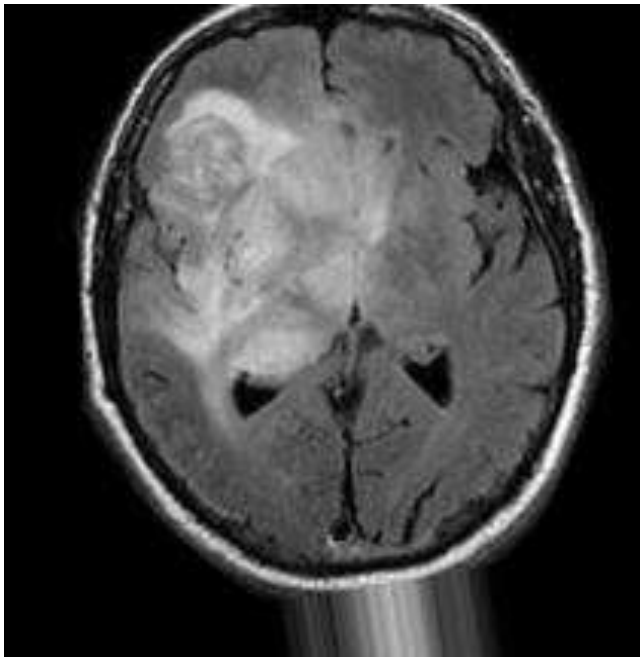


**Figure2:-** NoTumorimages.



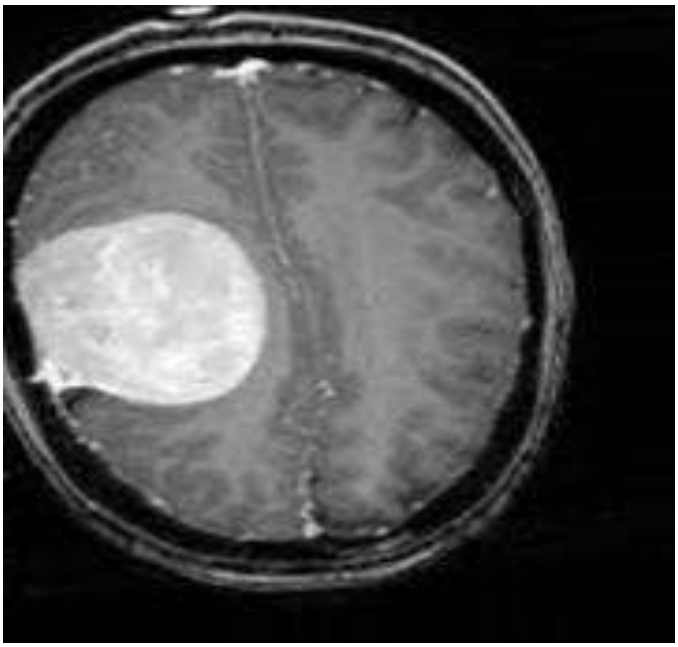


**Figure3:-** Tumorimages.

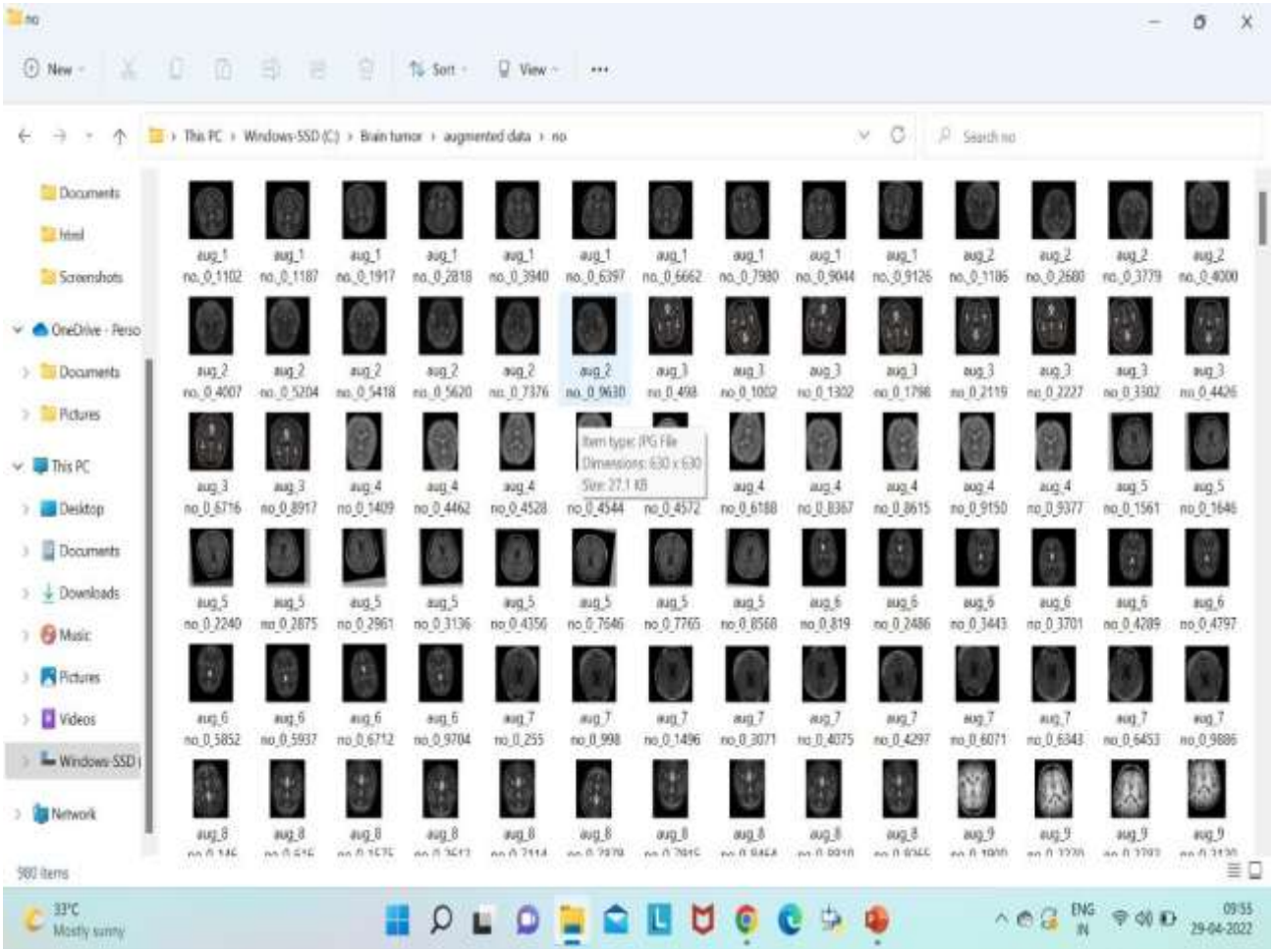



**Figure-2:-** NoTumor.

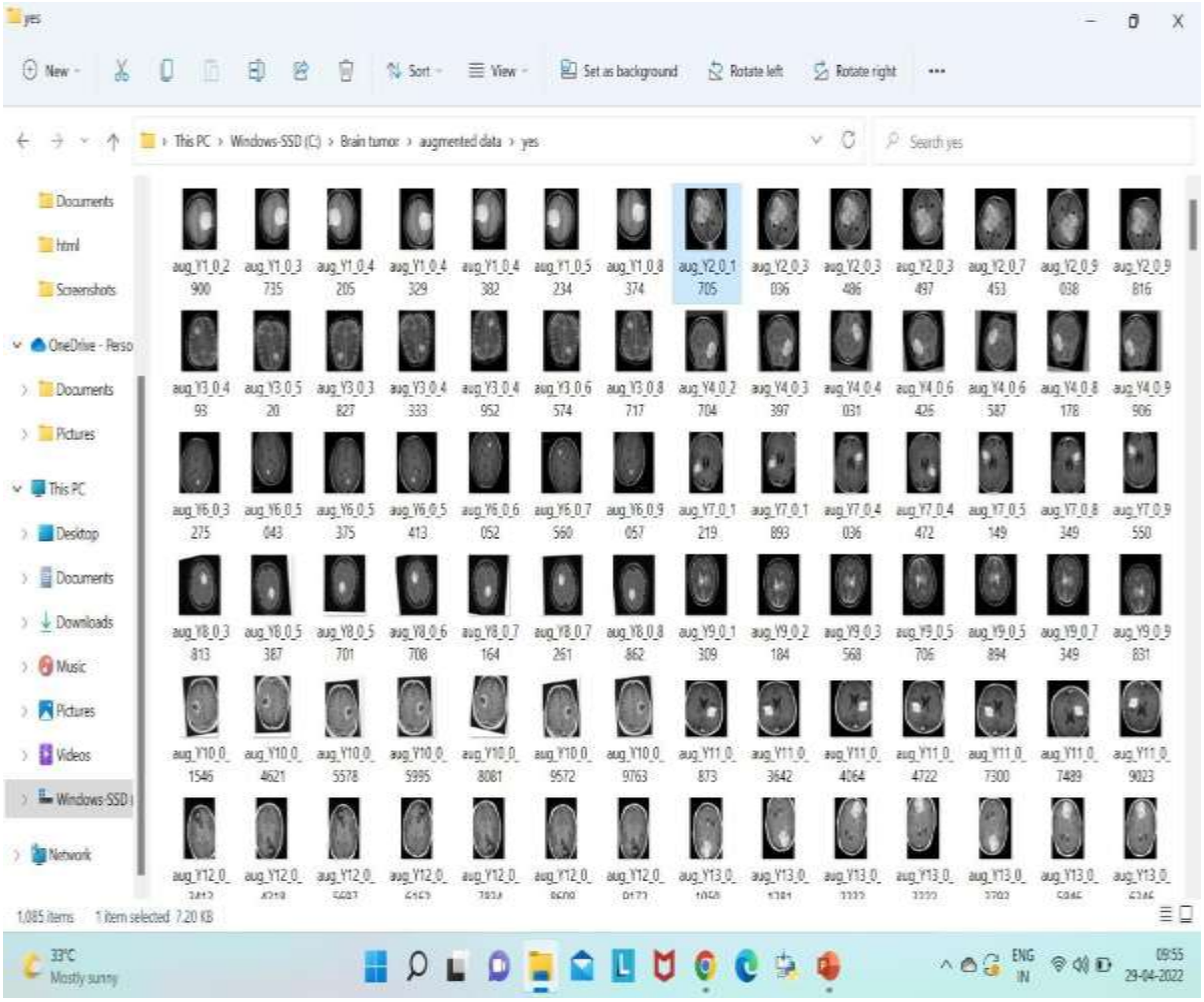



**Figure-3:-** yes.

**DataPre-processing:**

Datapre-processingisatechniquethatisusedtoconvertrawdatatointocleandataset**.**

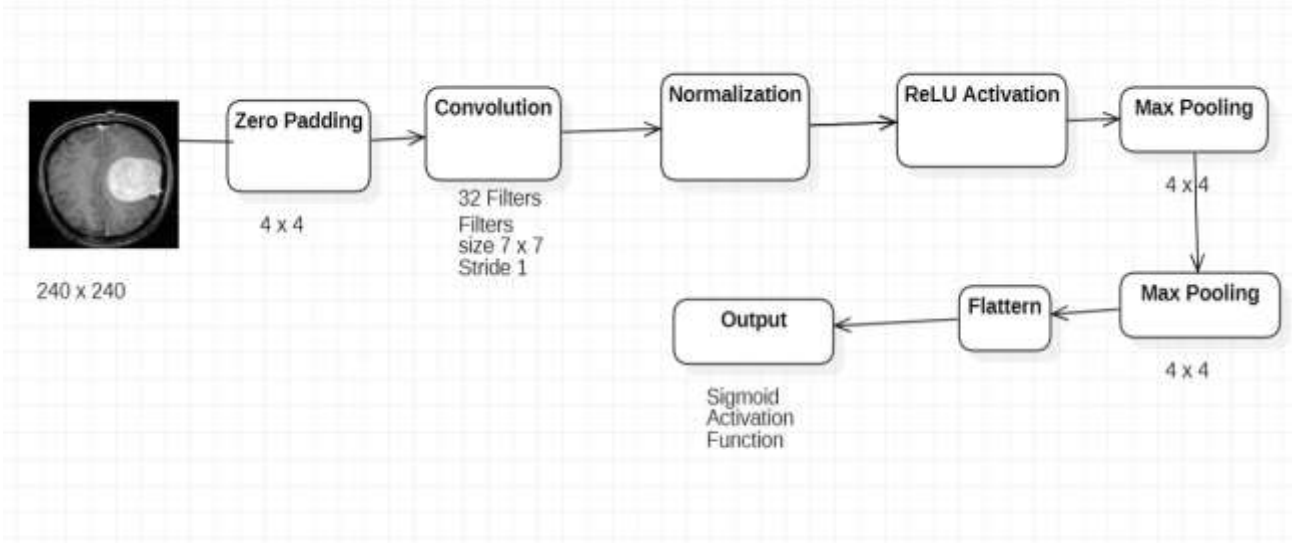



**Figure-4:-**

The process involves total of nine layers as shown in fig. 4. At first an image is taken asinput. The zero-padding layer applied with dimensions 4x4. It is followed by convolutionlayer. There are 32 filters of 7*7 dimension. A stride of one is applied. Convolution isfollowed by normalization which scales the values of input matrix in between 0 to 1. ThenReLu activation function will output the value directly if it is positive, otherwise it willmake it zero. The dimensions of the output of this layer are 238x 238 x 32. Next layer ismax pooling with a filter of size 4 x 4 and the output image dimensions are 59 x 59 x 32.The same max pooling operation is repeated. Dimensions of output now is 14 x 14 x 32.After that, there is flatten layer. Flatten layer consists of 6272 (14x14x32) neurons. It isfollowed by output layer which is the last layer. Output layer uses sigmoid activationfunction.

**Inputlayer**

Input Layer takes an image of dimensions specified dimensions as input. Any image thatwill be given as input needs to be resized to the specified dimensions. If an input ofdifferentsizeisprovided, theinterpreterthrowsanerrorthattheimageisofinvalidshape.Therefore,resizingisnecessary.

**Zeropaddinglayer**

The firstandlastelementsofthefirstandlastrowareaccessedbytheconvolutionfilter only once. To overcome this issue, we use zero-padding. It adds a layer of zeros so that theprediction is not affected negatively and the corner elements are visited more number oftimes.Wehave useda2x2zeropadding

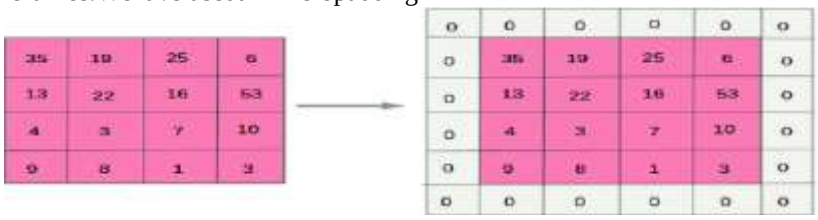



**Figure-5:-**

**Convolutionlayer**

Theconvolutionlayeristhelayerwherethefilterisappliedtoourinputimagetoextractordetect its features. A filter is applied to the image multiple times and creates a feature mapwhichhelpsinclassifyingtheinputimage.

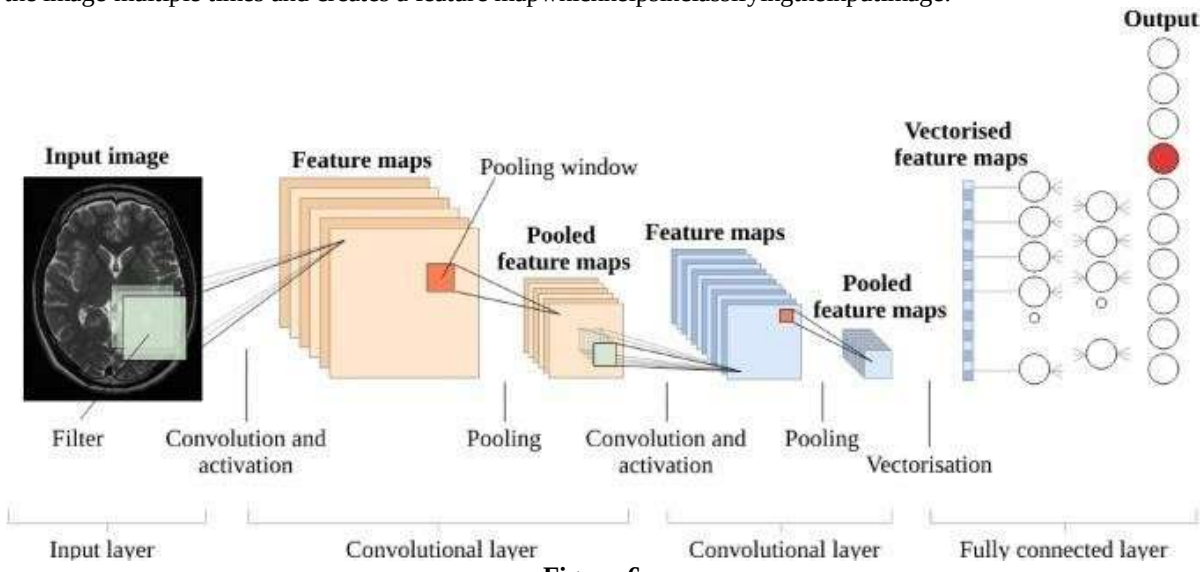



**Figure-6:-**

**Maxpoolinglayer**

Pooling layers are used to reduce the dimensions of the feature maps. Thus, it reduces thenumber of parameters to learn and the amount of computation performed in the network.The pooling layer summarizes the features present in a region of the feature map generatedby a convolution layer. The max pooling filter moves through the image and for everyiteration, it extracts the maximum value from the casted filter as shown in fig. 3.5. In theproject,wehave usedtwo MaxPoolinglayers,eachoffiltersize 4x4.

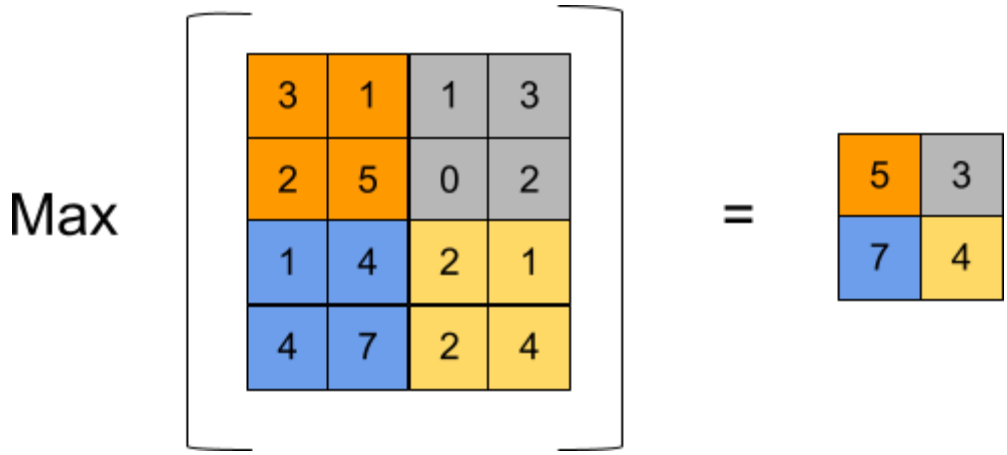



**Figure-7:-**

**Flattenlayer**

Flattening is converting the data into a 1-dimensional array. The number of neurons inflatten layer can be calculated by multiplying the width, height and depth of the output ofpooling layer. For example,if output of pooling layeris of size (12, 15, 7) then thenumber of neurons in flatten layer will be 12 x 15 x 7 = 1260 neurons. It can further beconnected to Dense layers to perform regression or classification tasks for prediction asrequired.

**Outputlayer**

Output layer is the layer used to extract the model's output. It may or may not have anactivation function. In our case, i.e. binary classification, we have used sigmoid activationfunction. The sigmoid activation function is used for binary classification becauseitsoutputranges between 0 and 1. A threshold value can be set,if the output is above thethreshold, we can say that the output is positive, And if the output is below the specifiedthresholdvalue,thepredictioncanbesaidtobenegative.Generallyinmedicalapplications,thethresholdvalueisveryhighasthepredictionneedstobemoreaccurate.

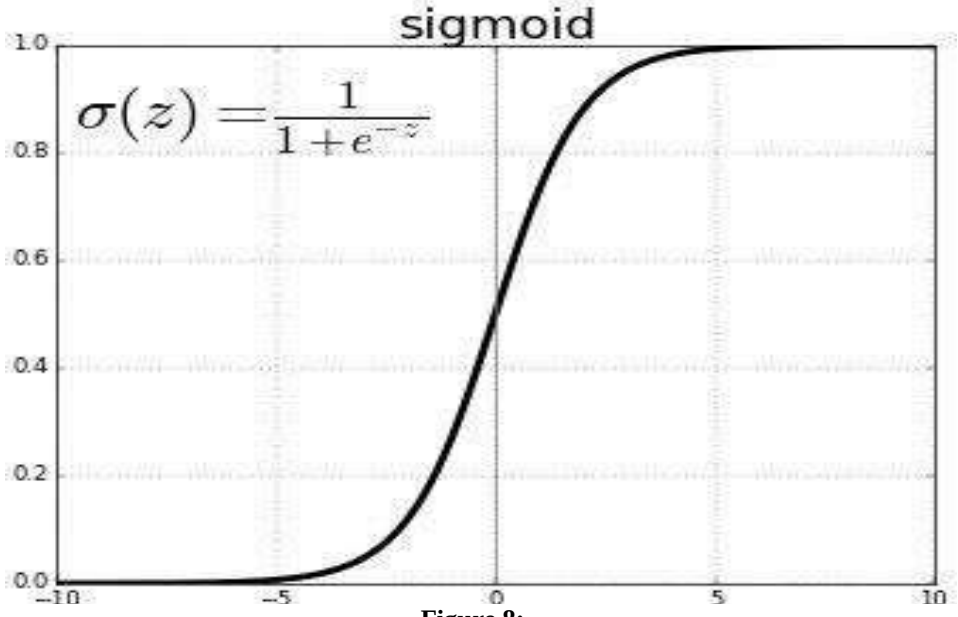



**Figure 8:-**

**Algorithms:**

This section talks about the algorithm used for the problem statement. We used convolutionalneural network. The brain tumor MRIs dataset acquisition has been used to implement theproposed methods. This method is used to

designed for extraction of tumors with accuracy andcomposednumberofstagesareincludingimagecapturing,edgedetection,andclassificationoftumor.

**ConvolutionalNeuralNetwork(CNN):**
In deep learninga convolutionalneuralnetwork isa classofdeepneural networks, mostcommonly applied to analyze visual image. Now, when we think of a neural network we thinkaboutmatrixmultiplicationsbutthatisnotthecaseinconvnet.

FortheCNNModel,to providebettertreatment.Theabnormalgrowthofcellscalledtumor.

Usually, CTscanorMRI usedtodetecttumor.

The name of "Convolutional Neural Network" performs the mathematical operation calledconvolution.Convolution isaspecialized kind oflinearoperation.Indeeplearning,aconvolutional neural network (CNN) is a class of deep neural networks, Convolutional networksare simply neural networks that use convolution in matrix multiplication in at least one of theirlayers. ConvNets have been successful in Identifying faces, objects, diseases detection. Aconvolutional neural network consists of an input layer, output layer, as well as multiple hiddenlayers. CNN which is feedforward neural network and is widely used for image recognition andclassification. The Convolutional neural layers convolve the input and pass its result output tothe nextlayer.

## Results:-

Themodelistrainedwithanaccurateresulton85%ofpredictions.Theconfusionmatrix andaccuracyscorecanbeseeninfig.below

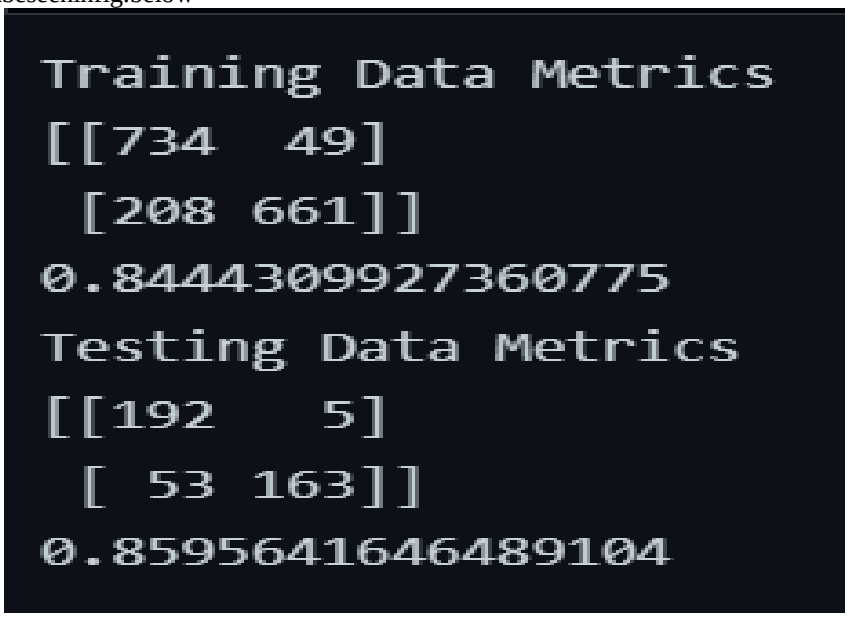



**Figure 9:-** ConfusionmatrixandAccuracyscore.

Createdawebsiteinterfaceinordertodemonstratethepredictedoutputofthemodel.

Theinterfacecanbeseeninfig.10, fig.11andfig12

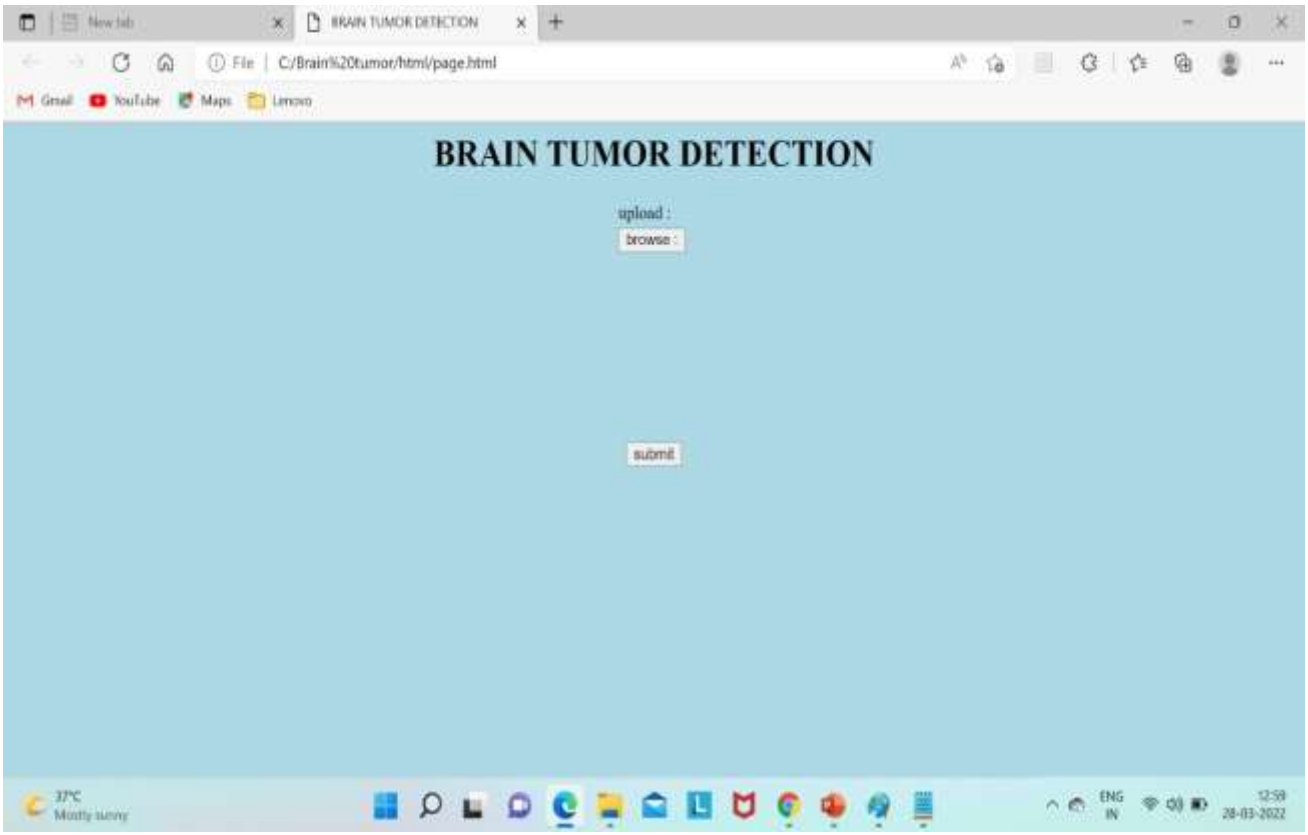



**Figure-10:-** Homepageofwebsite.

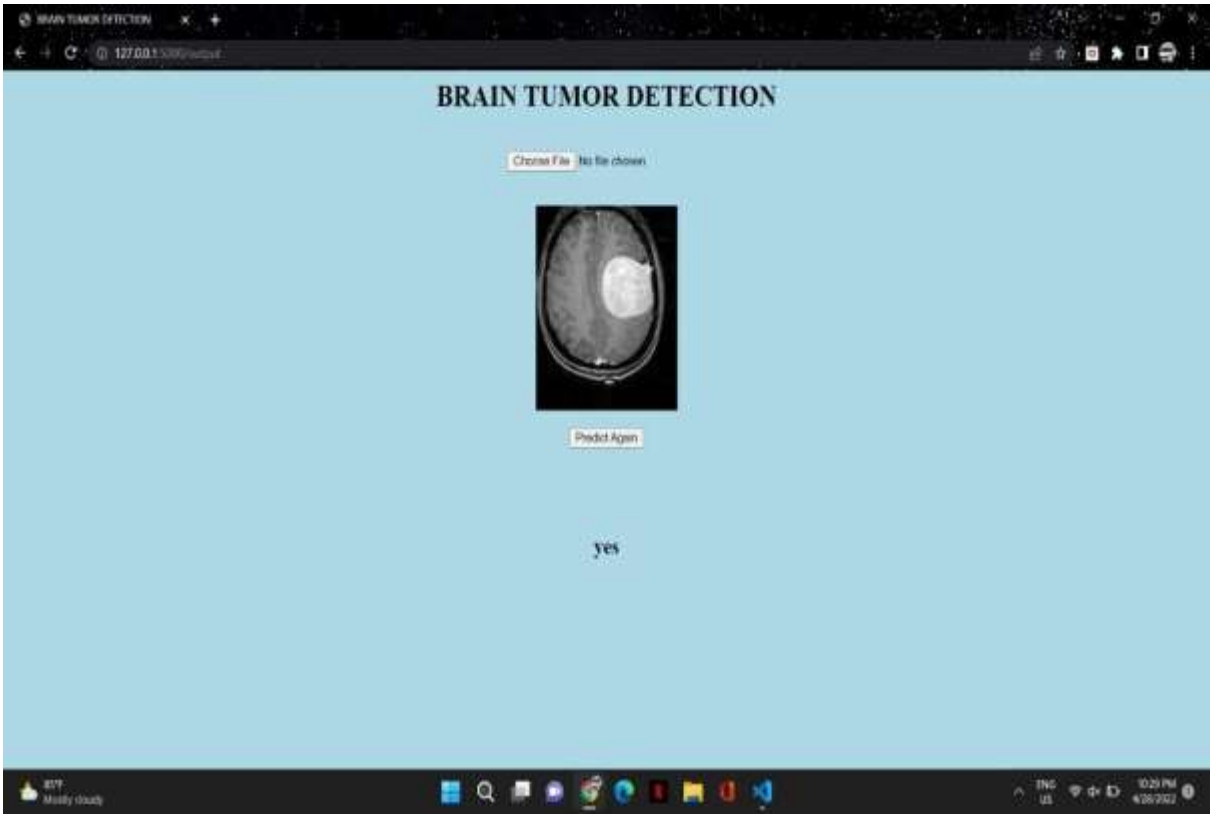



**Figure-11:-** PositivePrediction.

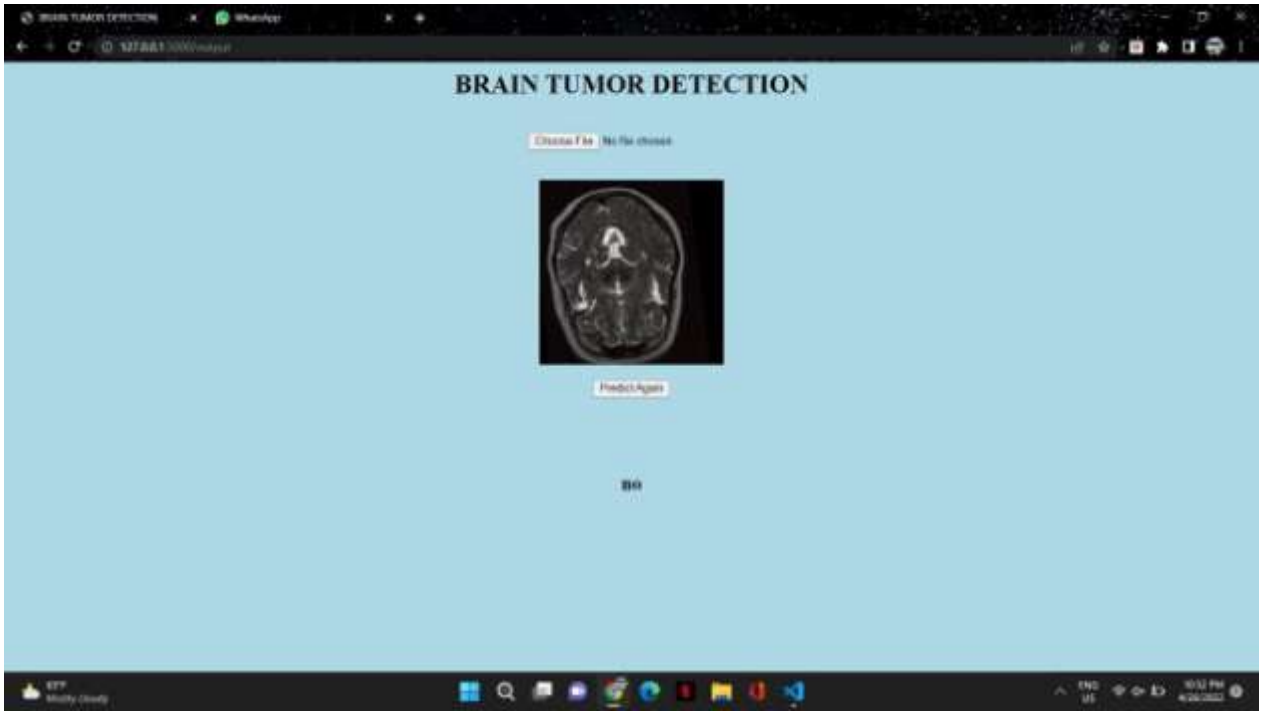



**Figure-12:-** NegativePrediction.

## Conclusion:-

Proposed a CNN model to detect whether a person is suffering from brain tumor or not. Inthis regard we trained the model with different types of images and tested the model to checkwhether the prediction goes right or wrong. The model we used is CNN. Wegot an accuracyof 0.85 using thismodel.Through the further development of segmentation techniquesinbrain tumors, this could be applied to other areas of radiology. Convolutional neural networksrepresent a growing field that will likely help radiologists provide more accurate care for theirpatients.

It is observed on experimentation that the proposed approach needs an input image of size of240*240. Any image of another size cannot be used and the input image should only be a grayscale image. Color image cannot be used as an input image. The model which we proposed canbe further improved by using any size image as input. Moreover, the accuracy which we gotthrough this CNN model is 0.88. The model can be further improved by some changes so thataccuracy can be increased further. Accuracy is important in medical diagnosis in order to getbetterresults.Inthiswayfurtherprocessing canbedonetoincreaseaccuracy.

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