MRI-BASED BRAIN TUMOR DETECTION USING CONVOLUTIONAL NEURAL NETWORK

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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ABSTRACT

An abnormal growth of cells in the brain is called a tumour and cancer refers to malignant tumour. The purpose of proposed work is to detect brain tumour and treat them more effectively. Computer vision plays a significant part, which diminishes the human judgement that gives precise result about. CT scans, X- Ray, and MRI looks are the common imaging strategies among attractive resonance imaging that are the foremost solid and secure. MRI identifies search miniature objects. In proposed work, the brain tumour detection is determined using deep learning algorithm. This algorithms are connected on the MRI image forecast of brain tumour is done exceptionally quick and a higher accuracy makes a difference in giving the treatment to the patients. Convolution neural network (CNN) is also used in detecting brain tumour detection and the performance is analyses. The proposed work focus on utilizing deep learning algorithms for the detection of brain tumors to enhance effectiveness in treatment. This is particularly crucial as timely and accurate detection can significantly impact patient outcomes. The incorporation of computer vision techniques, especially through the analysis of medical imaging such as CT scans, X-rays, and MRI, offers a promising avenue for precise detection and diagnosis. Magnetic Resonance Imaging (MRI) stands out among these imaging modalities for its ability to provide high-resolution images, enabling the identification of even minute abnormalities within the brain. Leveraging deep learning algorithms, particularly Convolutional Neural Networks (CNNs), facilitates rapid and accurate analysis of MRI images for tumor detection. By automating this process, the reliance on human judgment is reduced, leading to more consistent and reliable results.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The brain is the most important organ within the human body which controls the whole human body that includes other organs and also makes a des is on making. It is thefundamental control center of the central apprehensive framework and is responsible for performing the everyday voluntary and involuntary exercises within the human body. The tumour is basically a fibrous work of undesirable issue development interior brain that is used in unconstrained way. On this year at the age of 15, approximately 3,540 children get analysed with brain tumour. The correct way of understanding of brain tumour and its stages is anvital errand to anticipate and to carry out the steps in curing the sickness. To do so, magnetic resonance imaging is broadly utilized by radiologists to analyze brain tumour. The result of the examination carried out in this will uncover if the brain tumour is present or not. In this CNN is used as an algorithm to detect the brain tumour. CNN are a specialized type of artificial neural network that uses a mathematical operation called convolution in place of general matrix multiplication in at least one of their layers. They are specifically designed to process pixel data and are used in image recognition and processing.

1.2 LITERATURE SURVEY

The brain is an essential organ in the human body which control and cord in a test the tasks carried out by the other parts of the body. It is primarily the control center of thecentral nervous system and is responsible for performing the daily voluntary and in voluntary activities in the human body.

The tumour is a fibrous mesh of unwanted tissue growth inside the brain that proliferates in an unconstrained way. To prevent and cure the tumour, magnetic imaging (MRI) is widely used by radio logs to analyze stages of brain tumors. The result of this analysis reveals the presence of the brain tumour.

Appear as a front-line brain tumor detection tool (without ionization radiation). In this manuscript, an unsupervised clustering approach for tumor segmentation is proposed. Moreover, used feature vector is used which is a mixture of Garbo wavelet features(GWF),histograms of oriented gradient (HOG), local binary pattern (LBP) and segmentation based fractal texture analysis(SFTA) features .Random forest(RF) classifier is applied for classification between three sub tumor regions such as complete, enhancing and non-enhancing tumor.

Brain Cancer Detection and Classification System have been developed with the use of ANN. The image processing techniques such as histogram equalization, image segmentation, image enhancement, and feature extraction have been used. The proposed approach using ANN as a classifier for classification of brain images provides a good classification efficiency as compared to other classifiers. The sensitivity, specificity and accuracy are also improved. The proposed approach is computationally effective and yields good result.

The method applied is based on Hugh voting, a strategy that allows for fully automatic localization and segmentation of the anatomies of interest. It also used a learning techniques-based segmentation method which is robust, multi-region, flexible, and can be easily adapted to different modalities. Different amounts of training data and different data dimensional (2D, 2.5D, and 3D) are applied in predicting the final results. Convolution neural networks, Hugh voting with CNN, Vowel-wise classification, and Efficient patch-wise evaluation through CNN are used in analyzing the image.

In proposed work, the Convolution Neural Network (CNN) was implemented, which drives an overa ll accuracy of 91.3% and are call of 88%, 81% and 99% the detection of meaning a pituitary tumour respectively. Deep learning architecture by leveraging2D convolution neural networks for the classification of the different types of braintumour from MRI images lice.

In this paper techniques like data acquisition, data per processing, per –model, model optimization and hyper parameter tuning are applied. More over the 10-fold cross validation was performed on the completed at a set to check for the generalize ability of the model.

1.3 BRAIN TUMOUR

A brain tumor is a mass or growth of abnormal cells in the brain. Many different types of brain tumors exist. Some brain tumors are noncancerous, while others are malignant.

Begin in brain or can begin in other parts of body and spread to brain as secondary (metastatic) brain tumour and there are several types of brain tumour such as:

1. **Benign brain tumour :** It causes many serious issues. Noncancerous tumors grow slowly and do not spread to other tissues. They have more clearly defined borders, allowing for surgical removal, and they do not come back after removal.
2. **Malignant brain tumour** : It is cancerous, growing rapidly and capable of spreading to other parts of the brain or central nervous system, which can lead to life-threatening complications.
3. **Primary brain tumour :** it can develop from our brain cells the membranes that's unrounded don brain.it can benign or cancerous.

1.4 DETECTION OF BRAIN TUMOUR

Magnetic resonance imaging and computed tomography scans are used most often to look for brain diseases. These scans will almost always show a brain tumour, if one is present. Doctors can often also get an idea about what type of tumour it might be, based on how it looks on the scan and where it is in the brain. It is categorized into primary and secondary brain tumour

1. A primary brain tumour originates in brain. Many primary brain tumour are benign
2. A secondary brain tumor, also known as a metastatic brain tumor, occurs when cancer cells spread to the brain from another organ, such as the lung or breast.

1.4.1 CT SCAN

CT scans are a method for doctors to obtain a more detailed scan of the human body than they could with an X-ray machine. This can be done with or without contrast. Contrast is achieved in a CT scan of the head by using a special dye that helps doctors see some structures, such as blood vessels, more clearly.

1.4.2 MRI SCAN

In MRI scan a special dye is used to help doctor detect tum ours. An MRI is different from a CT scan because it doesn't use radiation, and it generally provides much more detailed pictures of the structures of the brain itself.

1.4.3 ANGIOGRAPHY

Angiography uses a dye that's injected into artery, usually in the groin area. The dye travels to the arteries in brain. It allows doctor to see what the blood supply of the tum ours looks like. This information is useful at the time of surgery

1.5 PROPOSED METHODOLOGY

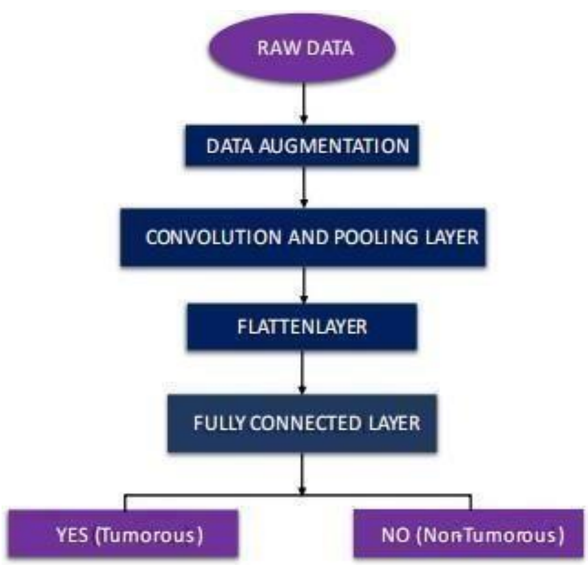

Figure1.5Proposed System

Raw data is given as data set which holds 3000 images of brain tumour and non-brain tumour MRI images. This data set is taken as an input and further proceed into data augmentation , it is a algorithm which utilize data information and form integrated model and it has the ability to improve the accuracy of data set then these model proceed into convolution layer which is image filtering used to process of modifying image such as shaping, contracts, brightness, pixel-ed its then the image is further proceed into max pooling layer used to reduce the dimensions of the feature maps, here flatten layer is used to convert the data of images into one dimensional array which is used as input for then ext-layer that is fully connected layer.

In fully connected layer, the flatten layer output is used as input which will classifies the object and identifies the pattern in the input image data, which produces the output whether the image is Brain tumour or non-Brain tumour.

CHAPTER 2

CONVOLUTIONAL NEURAL NETWORKS

2.1 INTRODUCTION

A convolution neural network is a network architecture for deep learning which learns directly from data, eliminating the need for manual feature extraction. CNN are particularly useful for finding patterns in images to recognize objects, faces, and scenes. They can also be quite effective for classifying non-image data such as audio, time series and signal data. CNN provide an optimal architecture for uncovering and learning key features in image and time-series data. CNN area key technology in applications such as:

1. **Medical Imaging**: CNN can examine thousands of pathology reports to visually detect the presence or absence of cancer cells in images.
2. **Audio Processing**: Keyword detection can be used in any device with a microphone to detect when acer ta in word or phrase is spoken-(‘Hey Siri!’).CNN scan accurately learn and detect the keyword while ignoring all other phrases regard less of the environment.
3. **Stop Sign Detection**: Automated driving relies on CNN to accurately detect the presence of a signor other object and make decisions based on the output.
4. **Synthetic Data Generation**: Using Generative Adversarial Network new images can be produced for use in deep learning applications including face recognition and automated driving.

2.2 CONVOLUTIONAL NEURAL NET WORK ALGORITHM

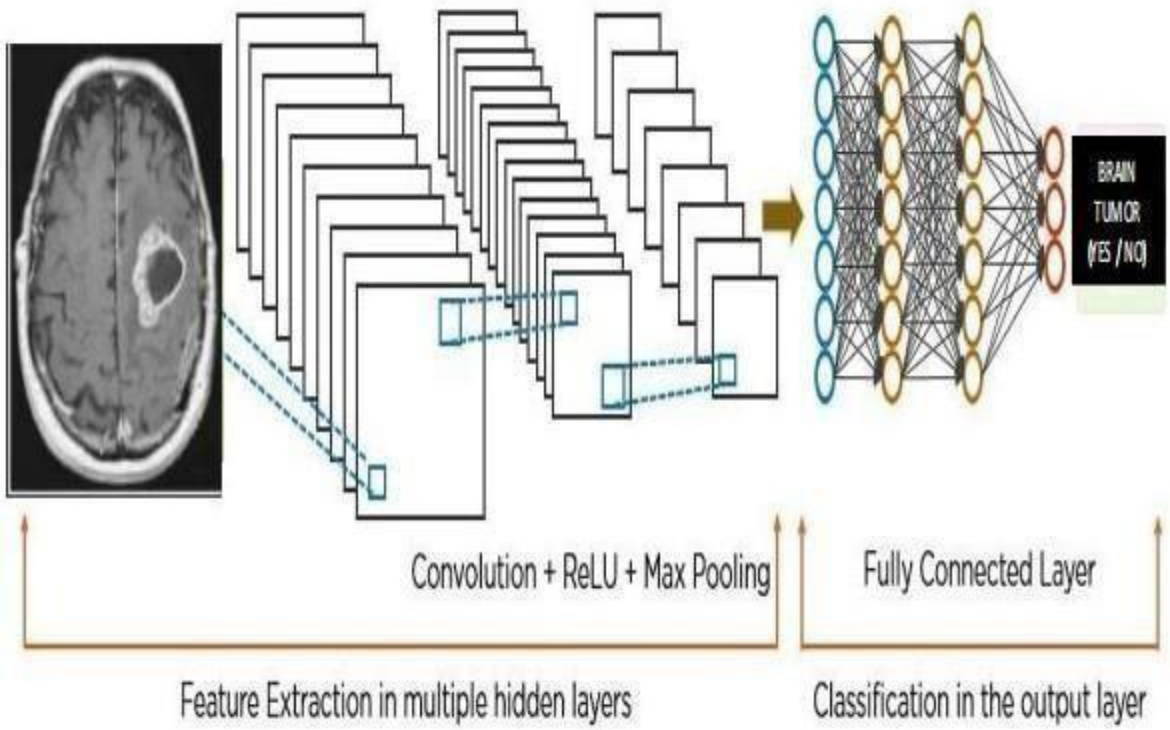

Figure2.1 Architecture of CNN

Convolution Neural Network or CNN is a type of artificial neural network, which is widely used for image/object recognition and classification. Deep Learning thus recognizes objects in an image by using a CNN.CNN are playing a major role in diver set asks/functions like image processing problems, computer vision tasks like localization and segmentation, video analysis, to recognize obstacles in self-driving cars, as well as speech recognition in natural language processing.

Figure 2.1 which implies the architecture of CNN in which images is given as input and further proceeded to feature extraction In multiple hidden layer with help of convolution layer, ReLU layer, pooling layer, flatten layer then these output is given as an input to the fully connected layer as shown in Figure 2.1 which goes under further classification of neural network layer such as input layer, hidden layer, output layer.

2.2.1 CONVOLUTIONAL LAYER

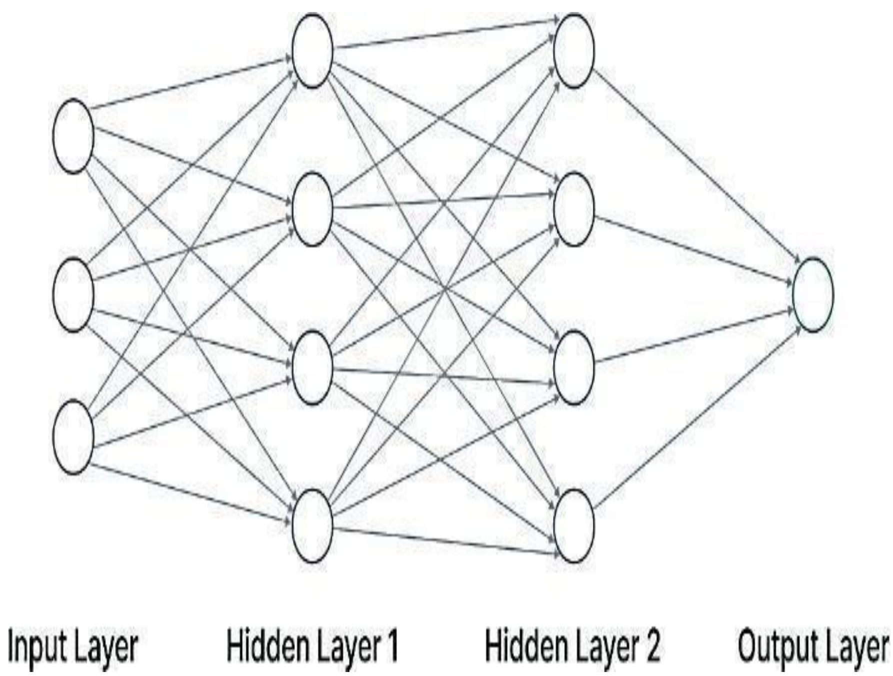

Figure2.2 Convolutional layer

A convolution converts all the pixels in its receptive field into a single value as shown infigure2.2.in this applying convolution to an image, it will be decreasing the image size as well as bringing all the information in the field together into a single pixel. The final output of the convolution layer is a vector.

Over multiple iterations, the kernels weeps over the entire image. After each iteration, a dot product is calculated between the input pixels and the filter, as shown in Figure 2.2. The final output from the series of dots is known as a feature map or convoluted feature. Ultimately, this layer converts the image into numerical values, enabling the CNN to interpret the image and extract relevant patterns from it.

2.2.2 RELU LAYER

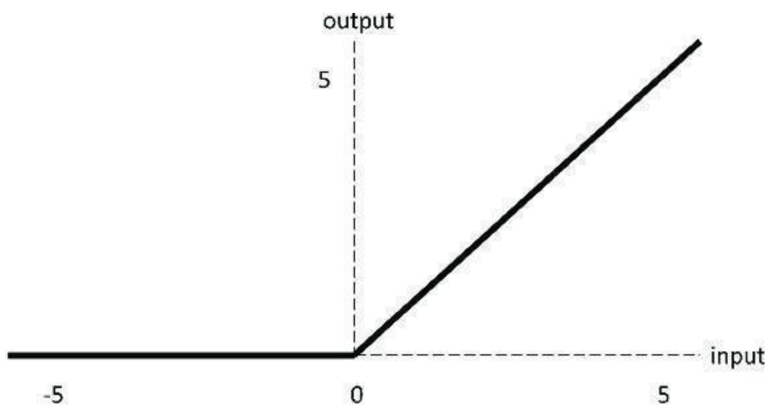

Figure2.3 Relu layer

ReLU stands for Rectified Linear Unit. Once the feature maps are extracted, the next step is to pass them through a ReLU layer. ReLU performs an element-wise operation and sets all the negative pixels to 0. This introduces non-linearity to thenetwork, and the generated output is a rectified feature map.

In this layer we remove every negative value from the filtered image and replace it with zero as show ninfigure2.3. This function only activates when the node input is above a certain quantity. So, when the input is below zero the output is zero

2.2.3 POOLING LAYER

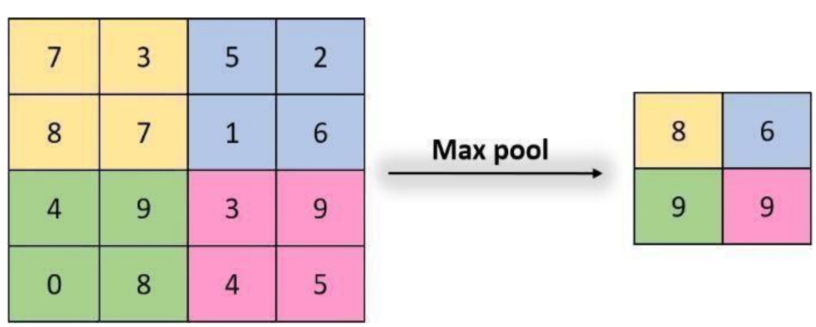

Figure2.4Pooling layer

Max Pooling layer also sweeps a kernel or filter across the input image. But unlike the convolution a layer, the pooling layer reduces the number of parameters in the input and also results in some information loss.

Max Pooling is a pooling operation that selects the maximum element from the region of the feature map covered by the filter. In figure 2.4, the output after max-pooling layer would be a feature map containing the most prominent features of the previous feature map

2.2.4 FLATTENING LAYER

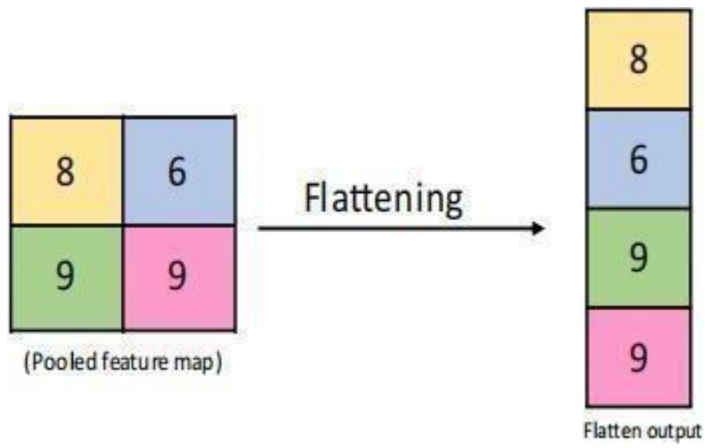

Figure2.5 Flattening Layer

Flatten layer is used to make the multidimensional input into one- dimensional as shown in figure 2.5, commonly used in the transition from the convolution layer to the fully connected layer. Converting the data in the one-dimensional array, flatten the output convolution layer. To create single long features vector. It connected to final classification model (fully connected layer)

2.2.5 FULLY CONNECTED LAYER

The FC layer is where image classification happens in the CNN based on the features extracted in the previous layers. Fully Connected Layer is simply, feed forward neural networks. Fully Connected Layers form the last few layers in the network. The input to the fully connected layer is the output from the final Pooling or Convolution Layer, which is flattened and then fed into the fully connected layer .Here, fully connected means that all the inputs or nodes from one layer are connected to every activation unit or node of then exit layer.

2.3 DEEP LEARNING

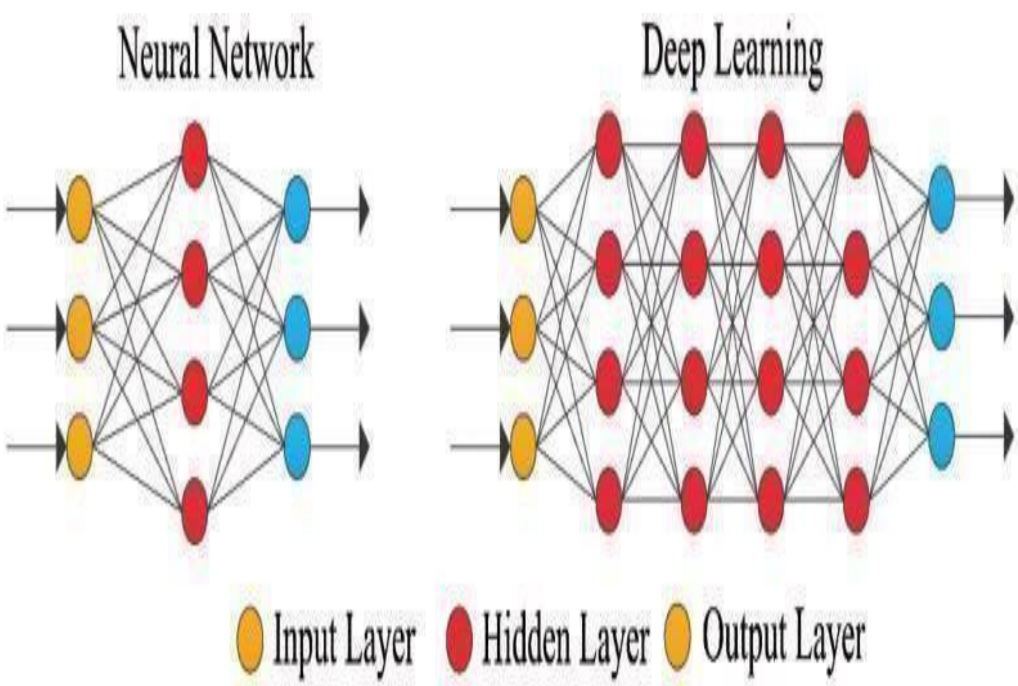

Figure2.6 Deep learning network

Deep learning is a type of machine learning and artificial intelligence (AI) that mimics the way humans acquire certain types of knowledge. It is a crucial component of data science, which includes statistics and predictive modeling. Deep learning differs fundamentally from conventional machine learning. In this example, a domain expert would need to invest a considerable amount of time in engineering a conventional machine learning system to detect the features.

1. Instruct computer.
2. Used in medical imaging –Does not require their liability of an expert.
3. Requires large amount of data–Produce good classification result.

Convolution Neural Network is the deep learning technique to perform image classification. The aim of this project is to build a system that would help in cancer detection from MRI images through convolution neural network.

CHAPTER 3

SOFTWARE SPECIFICATION

3.1 VISUAL STUDIO CODE

Visual Studio Code is a stream lined code edit or with support for development operations liked bugging, task running, and version control. It aims to provide just the to is a developer needs for a quick code-build- debug cycle and leaves more complex workflows to fuller featured IDE, such as Visual Studio IDE. VS Code extensions to browse databases, work with API, track productivity, and message teammates with out leaving the code editor.

Visual Studio Code is a free source code editor that fully supports Python and useful features such as real-time collaboration. It's highly customization to support class room the way you like to teach. To implement the brain tum our detection, visual studio code platform is used to get the output.

3.2 PYTHON

Python is a multi-paradigm programming language. Object-oriented programming and structured programming are fully supported, and many of its features support functional programming and aspect-oriented programming (including meta programming and meta objects). Many other paradigms are supported via extensions, including design by contract and logic programming.

Python uses dynamic typing and a combination of reference counting and a cycle-detecting garbage collector for memory management. It uses dynamic name resolution (late binding), which binds method and variable names during program execution. Python is commonly used for developing websites and software, task automation, data analysis, and data visualization. Since it's relatively easy to learn, Python has been adopted by many non-programmers such as accountants and scientists, of everyday tasks, like organizing finances.

3.3 MODULES USED IN PROJECT

A module is a file containing definitions and statements. A module can define functions, classes, and variables. A module can also include run able code. Grouping related code into a module makes the code easier to understand and use. It also makes the code logically organized.

1. Open CV
2. NumPy
3. TensorFlow
4. Keras
5. Matplotlib
6. PIB
7. PIL
8. SKLearnModel

3.3.1 OPENCV

Open-Source Computer Vision Library is a free and open-source software library for computer vision and machine learning. OpenCV was created to provide a common in a structure for computer vision applications and to speed up the incorporation of machine perception into commercial products used the OpenCV module in code to capture MRI images and perform some per-processing techniques on them for later use.

3.3.2 NUMPY

NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays. It is the fundamental package for scientific computing with Python. It contains various features including these important ones:

1. A powerful N-dimensional array object
2. Sophisticated(broadcasting)functions
3. Tools for integrating C/C++ and FORTRAN code
4. Useful linear algebra, Fourier transform, and random number cap abilities.

3.3.3 TENSOR FLOW

Tensor flow is a free and open-source software library for data flow and different able programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. It is used for both research and production at Google.

3.3.4 KERAS

Keras is an open-source neural-network library written in Python. It is capable of running on to of TensorFlow, Microsoft Cognitive Toolkit, R, Thea no, or Plaid ML. Designed to enable fast experimentation with deep neural networks, it focuses on being user-friendly, modular, and extensible.

Keras contains numerous implementations of commonly used neural-network building blocks such as layers, objectives, activation functions, optimizes, and tools to make working with image and text data easier to simplify the coding necessary for writing deep neural network code.

3.3.5 MATPLOTLIB

Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes easy things easy and hard things possible. Create publication quality plots. Make interactive figures that can zoom, pan, update.

3.3.6 PIL

PIL is the Python Imaging Library which provides the python interpreter with image editing capabilities. The Image module provides a class with the same name which is used to represent a PIL image.

3.3.7 SKLEARN MODEL

Model selection is a method for setting a blueprint to analyze data and then using it to measure new data. Selecting a proper model allows you to generate accurate results when making a prediction. To do that, you need to train model by using a specific data set. Then, you test the model against another data set.

3.4 DATA SET

Computer vision data set are used. Visual data provides multiple numbers of the great data set that are specific to computer visions such as Image Classification, Video classification, Image Segmentation, etc. Data set contains certain number of images which is grouped into tumorous group(YES)and non-tumorous group (NO).

1. The folder Yes contains 1500 brain tumour MRI images which are tumour us.
2. The folder NOcontainS1500 brain tumour MRI images which are non tumour Data set is taken from Kaggle platform. Here, Kaggle is an online community platform for Data scientists and machine learning enthusiasts. Kaggle allows users to collaborate with other users, find and publish datasets, use GPU integrated notebooks, and compete with other data scientists to solve data science challenges.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 HARDWARE SPECIFICATION

Hardware requirements for developing the application

Systems : Intel i5 10^{th} Gen

Ram : 8GB.

Speed : 1.40 GHz

Hardware requirements for running the

Application Device: PC

Ram : 4GB RAM

Speed : 1 GHz or Higher

4.2 SOFTWARE SPECIFICATION

Software requirements for developing the application

IDE : Visual Studio code

Operating system : Windows 7,8,10,11

Coding Language : Python

CHAPTER 5

BRAINTUMOURDETECTION

5.1 FLOWCHART

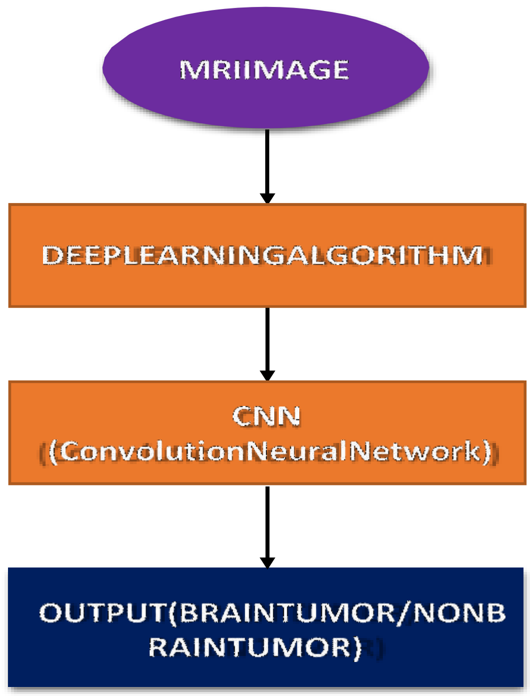

Figure5.1Flowchart of Brain tumour detection

5.2 BRAIN TUMOUR DETECTION

MRI (Magnetic Resonance Image) is given as input and output is in the form of whet her the image is Brain tumour or non-Brain tumour. MRI images are collected from raw data sets of kaggel platform, in which 3000 images are collected from the folder, where 1500 images are brain tumour images and 1500 images are non brain tumour images.

In deep learning, convolution neural network algorithm is used to extract the feature of the objects. Neural network is a series of algorithms that used to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates. Neural network contains contain input layer, hidden layer, output layer.

5.2.1 TRAINING MODEL

The training data process is comprised of three steps:

1. Feed -Feeding a model with data.
2. Define-The model transforms training data into text vectors (numbers that represent data features).
3. Test-Finally, test the model by feeding it test data (unseen data).

The pixels from the image are fed into the convolutional layer, which performs the convolution operation, resulting in a convoluted map. This convoluted map is then applied to a ReLU function to generate a rectified feature map. The image undergoes multiple convolutions and ReLU layers to locate features. Different pooling layers with various filters are employed to identify specific parts of the image. The pooled feature map is flattened and fed into a fully connected layer to obtain the final output.

5.2.2 TESTING MODEL

Testing data is used to check the accuracy of the model. Once Deep learning model is built (with training data), you need unseen data to test model. This data is called testing data, and you can use it to evaluate the performance and progress of algorithms’ training and adjust or optimize it for improved results.

Testing data should have two main criteria:

1. Represent the actual data set.
2. Be large enough to generate meaningful predictions.

CHAPTER 6

IMPLEMENTATION & O/P

6.1 TRAINING MODEL

The training of the model is done using python code in the platform of visual studio code. The code sets up the model with a single layer of Dense, which has two neurons. The first neuron is set to have an activation function of soft max, and the second neuron is set to have no activation function. The code also specifies that it will use cross-entropy as its loss function, and a dam as its optimizer. Code starts by importing the necessary libraries. It then imports a function from tensor flow that will be used to load the data into memory.

Define some of the variables for training set and test set as x_train, y_train, x_test, y_test respectively for training data. NumPy arrays containing all images in order. It then defines the variables needed for this code, such as cv2 which is used to import the OpenCV library an dos which is used to import the operating system functions and two lists are created, one for images with no tumour and one for images with a tumour. Image classification is done using data set of images and labels them as either containing a tumour or not, then the input size is set to 64, which h means that each image will be 64x64pixels.

The code then loops through each image in the data set ,resizesit to 64x64,and appends it to the data set. It also labels each image as 0 (no tumour) or 1 (tumour). Then it loads the data set and then splits the data into a training set and a test set. Next, it normalizes each of the datasets so that they are on the same scale. Then it creates two categorical variables for each of the data sets: one with 2 classes (y_train) and

One with 3 classes (y_test) and it rates over batches of data from x_train and y_train then it creates a new model. The model has 10epochs and uses categorical_cross entropy as the loss function with a dam as the optimizer.

It also sets metrics to be accuracy for evaluation purposes. For each batch, it fits the model using fit(), evaluates its performance on validation data using evaluate(), saves out a file called Brain Tumour 10Epochs Categorical. In HDF5 format, the information about the completed training iterations is printed. Next, two loss functions are defined: `categorical_crossentropy()`, which computes our loss.

6.2 SOURCE CODE:

```
import os os.environs['TF_ENABLE_ONEDNN_OPTS'] = '0' import cv2
import tensor flow as tf
from tensor flow.keras.models import load_model
from PIL import Image
import numpy as np
# Load the per-trained model
model = load_model('BrainTumor10EpochsCategorical.h5')#
Load and per process the input image
#image=cv2.imread('C:\\Users\\vigneshkumar\\Downloads\\BTD
code  -Copy\\datasets\\pred\\pred45.jpg')
image=cv2.imread('C:\\Users\\vigneshkumar\\Downloads\\BTD
code-Copy\\datasets\\yes\\Te-me_0014.jpg')
img = Image.fromarray(image)
img = img.resize((64, 64))
img = np.array(img) / 255.0  # Normalize pixel values
# Expand dimensions to match the model's expected input shape input_img
= np.expand_dims(img, axis=0)  #
Predict the class probabilities
predict_img = model.predict(input_img)#
Get the predicted class
predicted_class = np.argmax(predict_img, axis=1)[0]
```

```
# Print the prediction probability for the "Brain Tumor" class
print("Prediction Probability for Brain Tumor:", predict_img[0][predicted_class])
 # Check if the predicted class indicates a brain tumor
if predicted_class == 1:
print("Brain Tumor")
else:
print("Not a Brain Tumor")
```

6.2.1 GRAPH PLOT BETWEEN ACCURANCY AND VAL_ACCURANCY

Figure 6.1 graph shows the accuracy and val_accuracy of the brain tumour detection algorithm. The graph indicates that the accuracy of the brain tumour detection algorithm is high, with an accuracy of over98%. However, the Val accuracy is lower,ataround 95%.This suggests that the brain tumour detection algorithm is more accurate when used on data that is not from the validation set as shown in Figure6.1

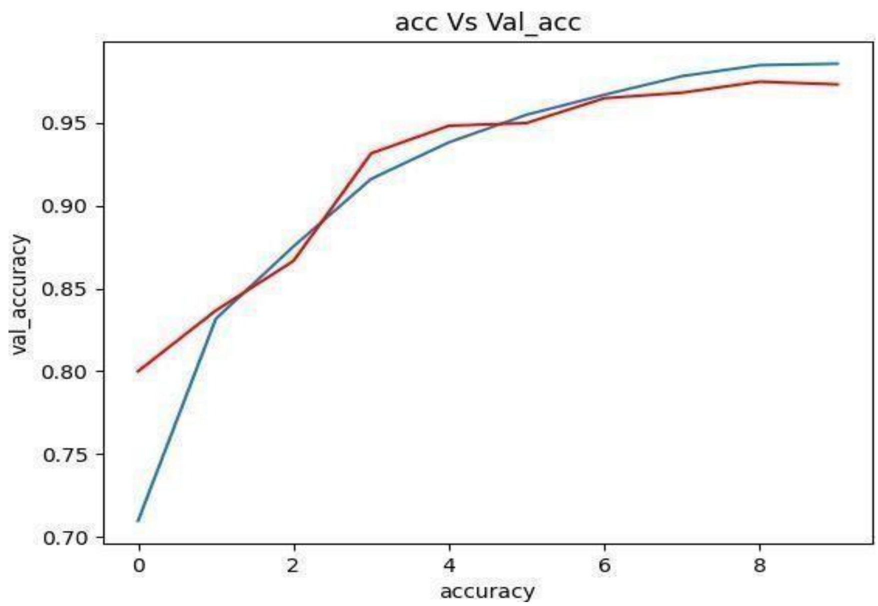

Figure6.2.1 graph plot between accuracy and Val accuracy

6.2.2 GRAPH PLOT BETWEEN LOSS AND VAL_LOSS

Figure 6 .2 graph below shows the loss vs val loss in brain tumour detection. As can be seen, the loss decreases as the number of epochs increases, while the val loss remains relatively constant. This suggests that the brain tumour detection model is not over fitting the data.

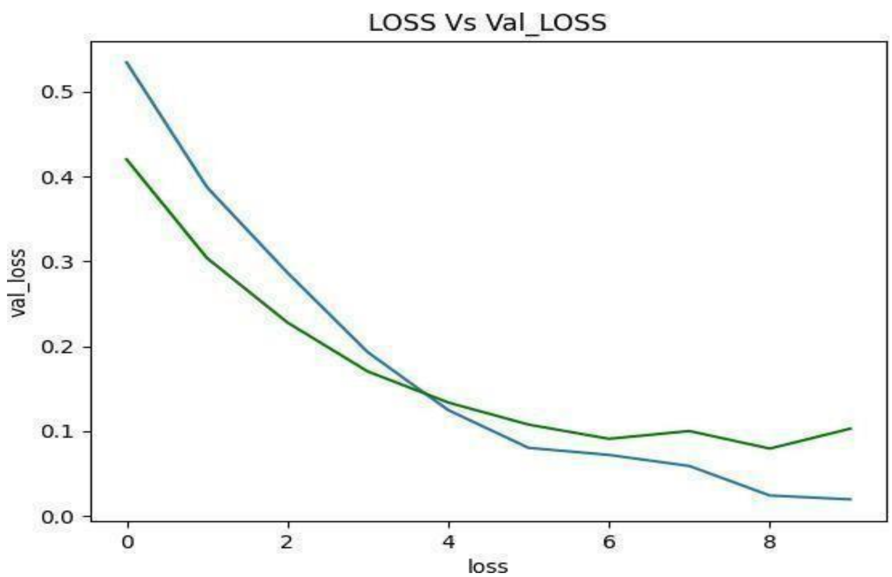

Figure6.2 graph plot between loss and val_Los

.

6.2.3 OUTPUT OF TRAINING MODEL

```
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
Epoch 1/10
150/150 [==============================] - 9s 49ms/step - loss: 0.5516 - accuracy: 0.7242 - val_loss: 0.4720 - val_accuracy: 0.7733
Epoch 2/10
150/150 [==============================] - 7s 43ms/step - loss: 0.3960 - accuracy: 0.8329 - val_loss: 0.3360 - val_accuracy: 0.8333
Epoch 3/10
150/150 [==============================] - 6s 42ms/step - loss: 0.2975 - accuracy: 0.8712 - val_loss: 0.2682 - val_accuracy: 0.8767
Epoch 4/10
150/150 [==============================] - 6s 43ms/step - loss: 0.2282 - accuracy: 0.9112 - val_loss: 0.1884 - val_accuracy: 0.9233
Epoch 5/10
150/150 [==============================] - 7s 44ms/step - loss: 0.1580 - accuracy: 0.9438 - val_loss: 0.1506 - val_accuracy: 0.9317
Epoch 6/10
150/150 [==============================] - 6s 43ms/step - loss: 0.1038 - accuracy: 0.9633 - val_loss: 0.1109 - val_accuracy: 0.9583
Epoch 7/10
150/150 [==============================] - 6s 42ms/step - loss: 0.0730 - accuracy: 0.9758 - val_loss: 0.0849 - val_accuracy: 0.9750
Epoch 8/10
150/150 [==============================] - 6s 42ms/step - loss: 0.0441 - accuracy: 0.9867 - val_loss: 0.0780 - val_accuracy: 0.9717
Epoch 9/10
150/150 [==============================] - 6s 42ms/step - loss: 0.0351 - accuracy: 0.9900 - val_loss: 0.0612 - val_accuracy: 0.9750
Epoch 10/10
150/150 [==============================] - 6s 42ms/step - loss: 0.0160 - accuracy: 0.9954 - val_loss: 0.1084 - val_accuracy: 0.9667
```

Figure6.3 Training model output

Figure 6.3 is the training model output which represent the trained model is over fit or not. Epoch is used to determine the best treatment options for brain tumour. The epoch results for loss and accuracy can be used to determine how well the brain tumour detection system is performing. If the loss is increasing, then the system is not performing well and needs to be improved. If the accuracy is decreasing, then the system is also not performing well and needs to be improved. But Figure 6.3 implies that the loss is decreasing with increasing in the accuracy for each epoch, here val stands for validation.

6.3 TESTING MODEL

- Testing of the model is done using python code by using visual studio code platform here the training model data is saved and used in testing model to get the output, whether the input of MRI image is Brain tumour or Not a Brain tumour.
- The code starts by importing the necessary libraries. It then imports a function from tensor flow called keras which is used to load models into memory. The code then imports PIL, which is used for loading images and converting them to NumPy arrays. Next, it loads the model that was created in the previous step with a call to load model().
- Finally, it creates an instance of Sequential, which will be used as a classifier and loads the Brain Tumour 10 Epochs Categorical .h5 (HDF 5format) file and then creates a new image object. The code then re-sizes the image to 64x64 pixels using array. Next, it converts the array of pixel values in to an numpy array.
- The code tries to load a model from the HDF5 format file, which is saved in the user folder and then create an image with dimensions of 64x64 pixels from that model. The code first loads the model into memory using load model of training model data set
- Then, it uses `cv2.imread(given input image path)` to load the image from that folder, resizes it to 64x64 pixels, and creates a Sequential model. This model is the image that will be used to train and predict whether it contains a brain tumor. Next, a model is created using our trained model, and it is generated by taking the maximum value out of all pixels in the model, allowing us to see where our predictions.

- Finally, the training model data is saved and used in testing model to get the output, whether the input of MRI image is Brain tumour or Not a Brain tumour. Then the code will print "Not a Brain Tumour" or “Brain Tumour”, if the input MRI image is not a brain tumour or brain tumour respectively.

6.3.1 OUTPUT FOR NON-BRAIN TUMOUR IMAGE

Figure6.1 represents the MRI image which is used as input to detect the output whether it is brain tumour or not a brain tumour image

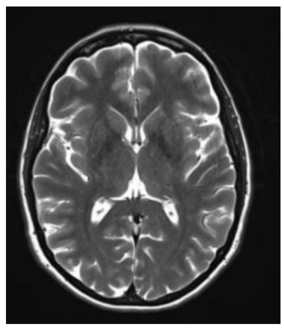

Figure6.1 MRI image

Figure6.2 represents the output is “Not a Brain Tumour”

```
1/1 [==============================] - 0s 193ms/step
Not a Brain Tumor
```

Figure6.2 output for non-brain tumour image

6.3.2 OUTPUT FOR BRAIN TUMOUR IMAGE

Figure6.2 represents the MRI image which is used as input to detect the output whether it is brain tumour or not a brain tumour image

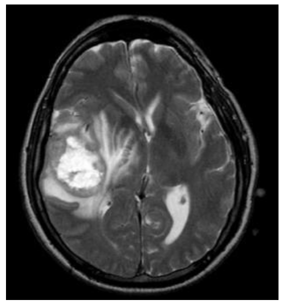

Figure6.2 MRI image

Figure6.3 represents the output is"Brain Tumour"

```
1/1 [==============================] - 0s 196ms/step
Brain Tumor
```

Figure6.3output for brain tumour image

CHAPTER 7

CONCLUSION

In recent years, demand for image-processing-based diagnostic computer systems has grown, enabling radiologists to speed up diagnosis while simultaneously assisting patients. The most deadly and life-threatening cancer, which affects many individuals globally, is the brain tumour. A variety of brain tumour segmentation and classification methods have been suggested to enhance medical image analysis. These algorithms, however, suffer from a number of drawbacks, including low contrast images, incorrect tumour region segmentation caused by some artifacts,a computationally complex method that needs more treatment time to correctly identify the tumour region, and existing deep learning methods need a large amount of training data to overcome over fitting. The proposed brain tumour detection and classification scheme in this paper aims to address the a fore mentioned concerns.

In the study, as a processing step, used layered in CNN architecture is proposed for brain tumour segmentation and a modified architecture is used for feature extraction and trained using the transfer learning.An experimental study reveals that the proposed method obtained an enhanced performance in visual and comprehensive information extraction compared to current methods.

The proposed classification method for the detection of brain tumour achieves an accuracy of 97.47% and 98.92%. The proposed method outperforms existing methods in terms of the detection and classification of brain tumour using MRI, as well as being more aesthetically pleasing and yielding superior results.

PUBLICATIONS

1. Vasanthakumar P, Vigneshkumar S, Selvakumar B, Kaliappan A (2024), “MRI based Brain Tumor Detection Using Convolutional Neural Network”, 2nd International Conference on Innovative Trends in Engineering and Sciences (ICITES`2024) organized by Bannari Amman Institute of Technology, Erode, Tamil Nadu on 26/03/2024.

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