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(REVIEW ARTICLE)

Brain tumor segmentation using convolutional neural network

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Abstract

Nowadays health is an essential factor in human life, among all the health complexities brain tumors are very critical to deal with. Though there are some existing techniques to classify the brain related deficiencies, there is no proper method to segment the process. MRI (Magnetic Resonance Imaging) and ultrasound techniques are vastly used in order to classify the brain condition all over the world lately. But there exist some limitations among those processes to keenly classify the brain tumor analysis, this segmentation using CNN is now very trusted as it has more accuracy compared to all the existing methods. This is introduced which can be applied using image detection and convolutional neural networks. Algorithm which is within popular and well motivating classification methods. The CNN produces an accuracy of 99.3% which is higher than any other existing methods and is low in complexity. Small kernels are used to perform this design.

Keywords: Support Vector Machine; CNN; Magnetic Resonance Imaging; Brain tumor

1. Introduction

According to a survey brain related deaths are vastly increasing day by day. Tumor is an unusual growth of tissues in a cell of the human body, generally the brain can also be affected by these kinds of tumors, these are known as brain tumors and they are of two types one is cancerous which is extremely dangerous named as Malignant, another one is benign.

Malignant will spread to various parts of the brain resulting in immediate fatal of the victim. Benign does not cause death because the growth of the tumor is slow which can be found in the early stage and can be restricted easily.

In the early stages MRI is used along with the CT and ultrasound techniques whereas the MRI stands top when compared to the other techniques

This continued over a few years until the depth in deep learning and artificial intelligence grew bigger which led to new techniques such as image detection and convolutional neural network CNN which can show greater accuracy in the results when compared to that of other techniques.

Deep learning models include SVM support vector machine and KNN k – means map, these are highly used architectures but the highest priority will be given to CNN among the others due to its high accuracy.

Nowadays people are suffering with many health hazards mainly in adults, gliomas are the common brain tumors and they are categorized into different grades malignant and benign in that malignant grow rapidly as it is a high grade gliomas, benign is a low grade gliomas.

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Conversely, Neural Networks (NN) and Support Vector Machine (SVM) are the usually used methods for their good enactment over the most recent few years11.

However freshly, Deep Learning (DL) models fixed a stirring trend in machine learning as the subterranean architecture can efficiently represent complex relationships without needing a large number of nodes like in the superficial architectures e.g. K-Nearest Neighbour (KNN) and Support Vector Machine (SVM) Consequently, they grew quickly to become the state of the art in unlike health informatics areas for example medical image analysis, medical informatics and bioinformatics.

2. Literature review

2.1. Heba Mohsen et al

MRI (Magnetic Resonance Imaging) and ultrasound techniques are vastly used in order to classify the brain condition all over the world lately. But there exist some limitations among those processes to keenly classify the brain tumor analysis, this segmentation using CNN is now very trusted as it has more accuracy compared to all the existing methods. This is introduced which can be applied using image detection and convolutional neural networks. Algorithm which is within popular and well motivating classification methods. The CNN produces the accuracy of 99.3% which is higher than any other existing methods and is low in complexity. Small kernels are used to perform this design.

2.2. Stefan Bauer et al

First step, the tumor is grown in the atlas based on a new multiscale, multiphysics model including growth simulation from the cellular level up to the biomechanical level, accounting for cell proliferation and tissue deformations. Large-scale deformations are handled with an Eulerian approach for finite element computations, which can operate directly on the image voxel mesh.

2.3. SF Bassett and H Prapavessis

A stochastic model for characterizing tumor texture in brain magnetic resonance (MR) images is proposed. The efficacy of the model is demonstrated in patient-independent brain tumor texture feature extraction and tumor segmentation in magnetic resonance images (MRIs). Due to complex appearance in MRI, brain tumor texture is formulated using a multiresolution- fractal model known as multifractional Brownian motion (mBm). Detailed mathematical derivation for mBm model and corresponding novel algorithm to extract spatially varying multifractal features are proposed. A multifractal feature- based brain tumor segmentation method is developed next. To evaluate efficacy, tumor segmentation performance using the proposed multifractal feature is compared with that using Gabor-like multiscale texton feature. Furthermore, novel patient- independent tumor segmentation scheme is proposed by extending the well-known.

3. Methodology

3.1. SVM

Support Vector Machine

- It is a supervised machine learning algorithm
- It can be used for both classification and regression problems
- It uses a technique called the kernel trick to transform your data
- Based on the transformations it finds an optimal boundary between the possible outputs

We perform classification by finding the hyperplane that differentiates two classes very well

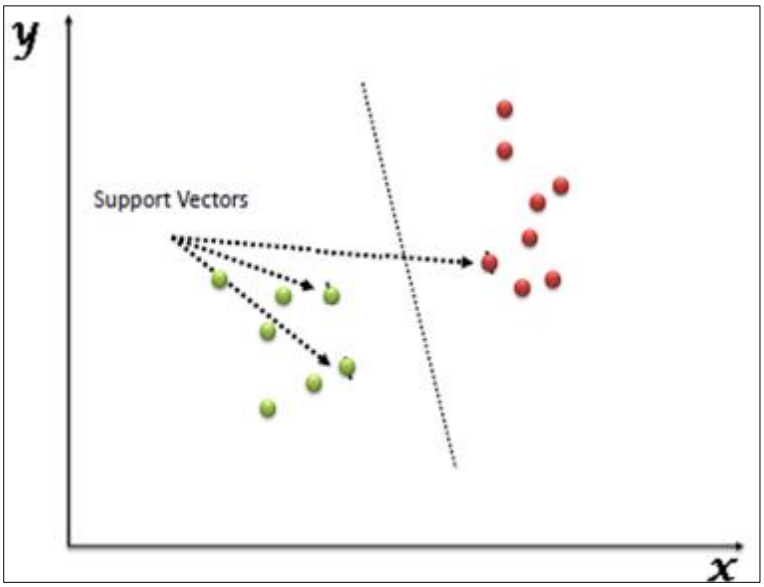

Figure 1 Support vector machine

3.2. CNN

Convolutional Neural Network

- CNN is an efficient recognition algorithm which is widely used in pattern recognition and image processing
- It has many features such as simple structure, less training parameters and adaptability
- It has become a hot topic in voice analysis and image recognition

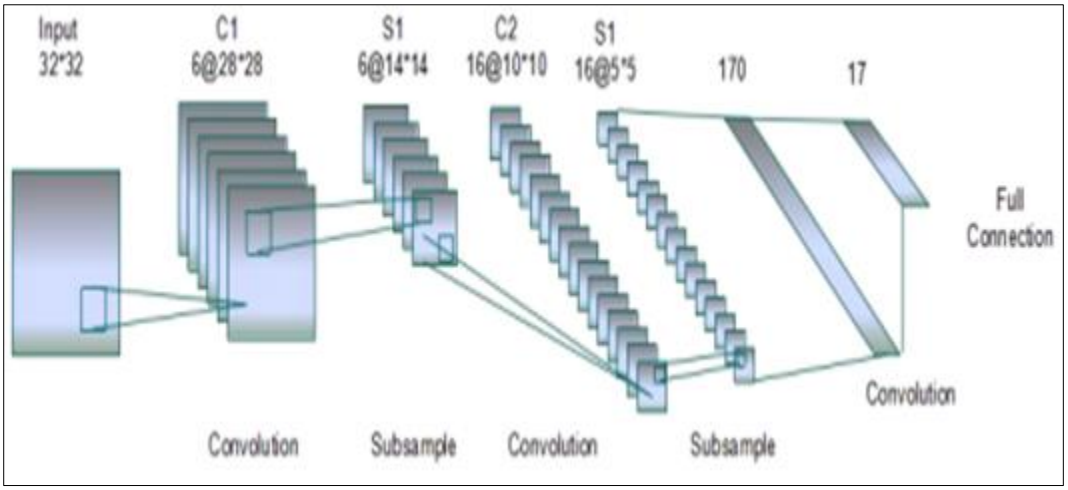

Figure 2 Convolutional neural network

4. Results and Discussion

4.1. Testing strategies

4.1.1. Unit Testing (UT)

- U.T Processes
- Black Box Testing
- White Box Testing

4.1.2. Data flow testing

It is a group of testing strategies that depend upon the paths that are selected by the control programs flow control to explore the events sequence combined to the condition of various variables and the data objects

4.2. Integration testing

The main use of this testing is to verify reliability and how it performs

4.3. User interface testing

This is a technique which is used for identifying the presence of defects under the test by GUI graphical user interface

4.4. Test cases

Table 1 Test cases

S.NO	INPUT	If available	If not available
1	Upload dataset	Dataset loaded	There is no process
2	Preprocessing	Read the dataset	We can't preprocess
3	Run SVM algorithm	Algorithm accuracy displayed	We can't run
4	Run CNN algorithm	Algorithm accuracy displayed	We can't run
5	Accuracy graph	Comparison graph displayed	We can't get comparison
6	Predict brain disease	User giving input & getting prediction result	Prediction not done

->If the input contains loaded dataset then the next step will be processed otherwise no

4.4.1. Process is done

- The loaded dataset will be read and preprocessed otherwise no preprocessing
- After running SVM and CNN algorithms the accuracy will be displayed along with the graph
- Predicting the brain disease through the test file input

4.5. Execution demo

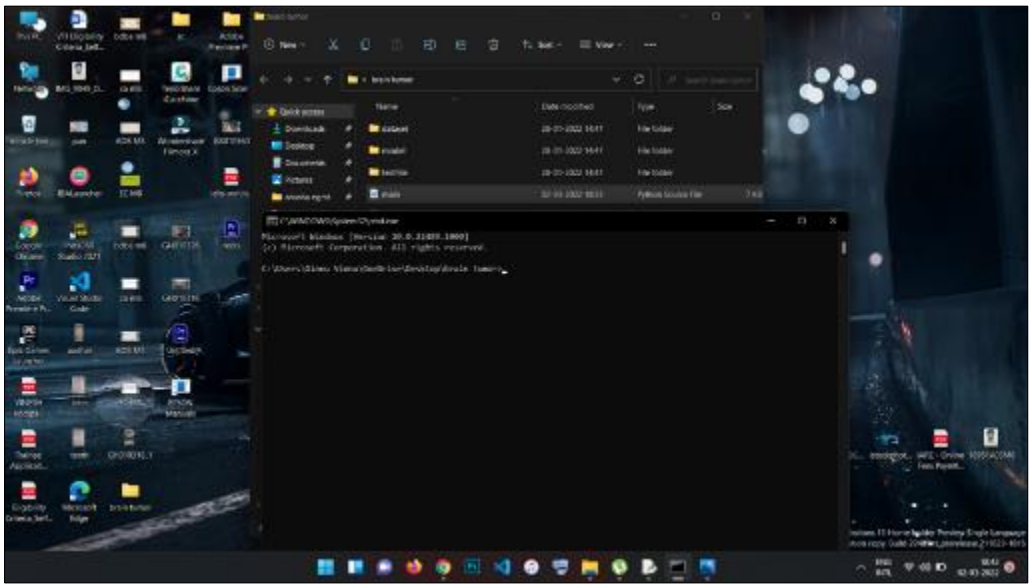

Figure 3 Execution 1

- This is the first step of execution
- Accessing the files from the local system

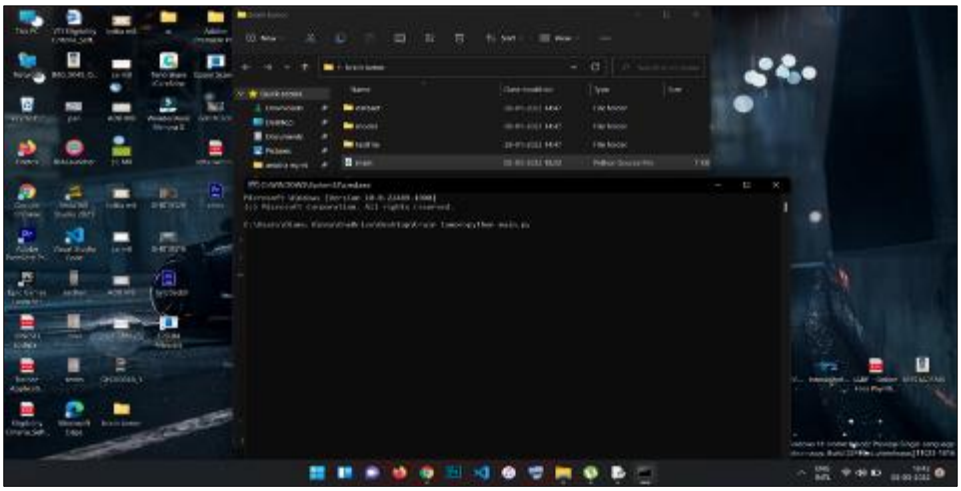

Figure 4 Execution 2

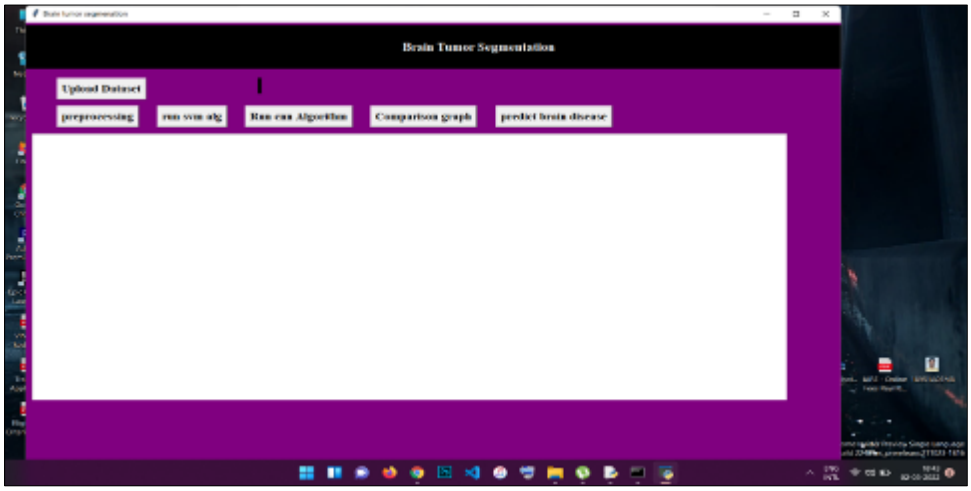

Figure 5 Execution 3

- This image depicts the interface of the project

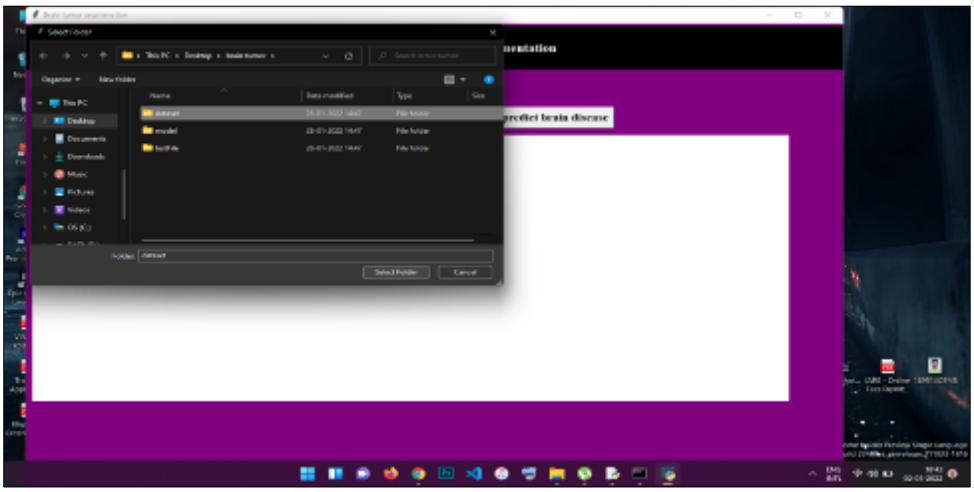

Figure 6 Execution 4

- Upload the dataset

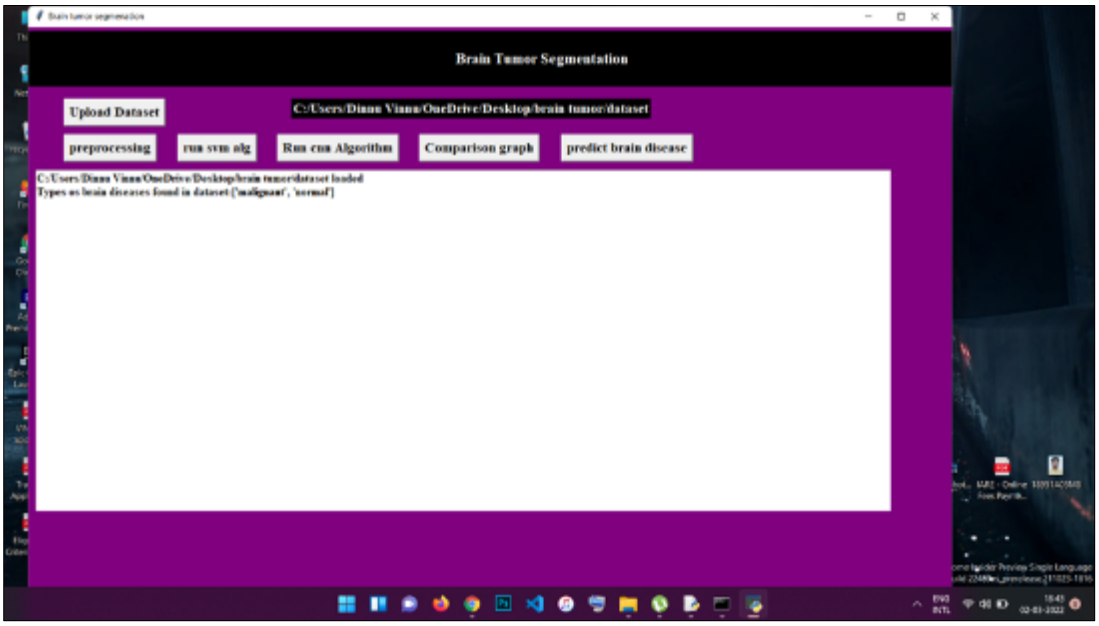

Figure 7 Execution 5

- Here we will preprocess the data to clean the dataset and
- Types of dataset will be shown here

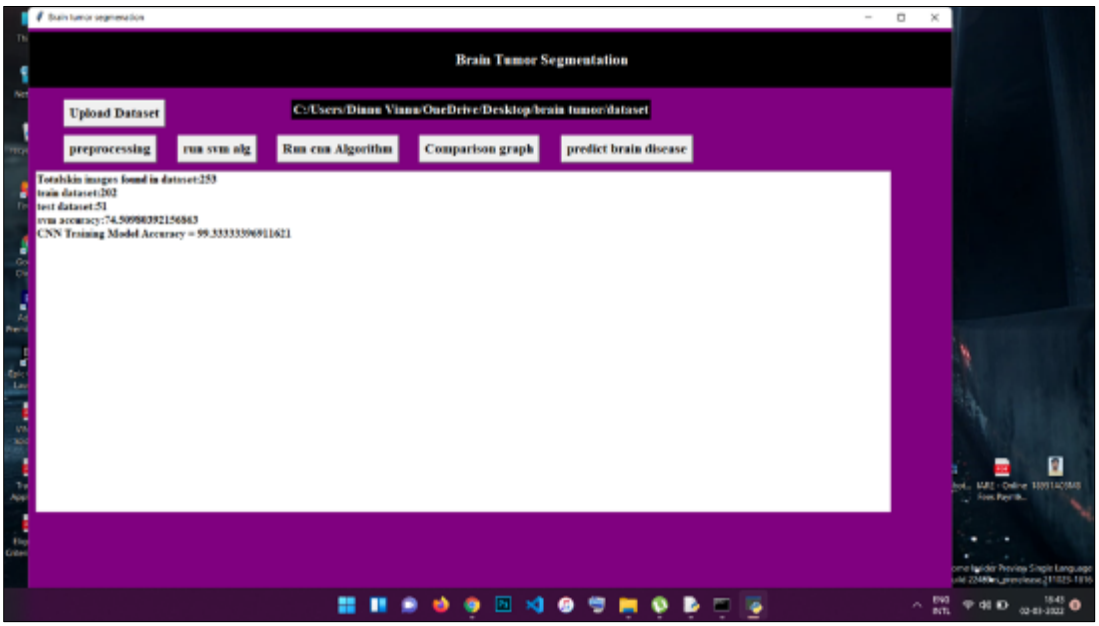

Figure 8 Execution 6

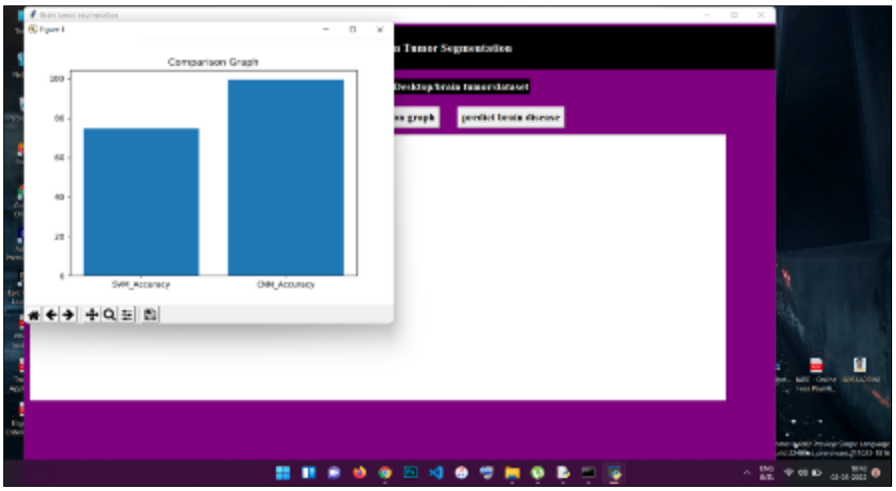

Figure 9 Execution 7

- Here there will be comparison between the SVM and CNN graphs

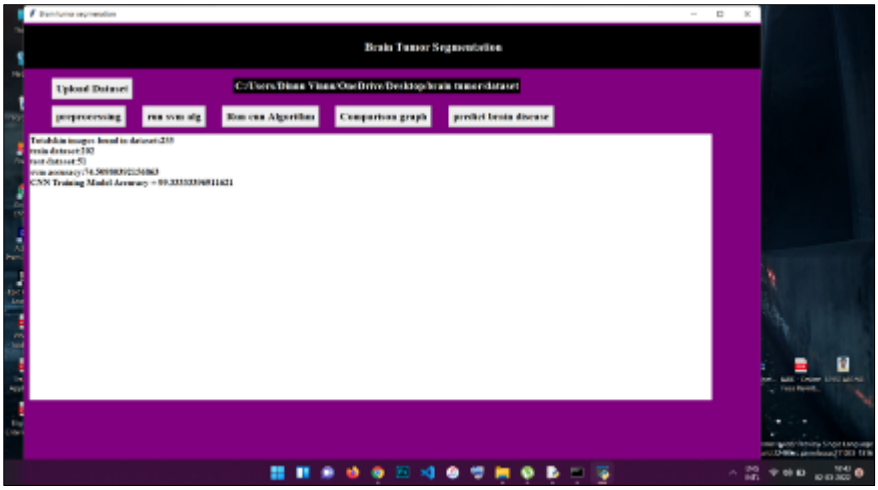

Figure 10 Execution 8

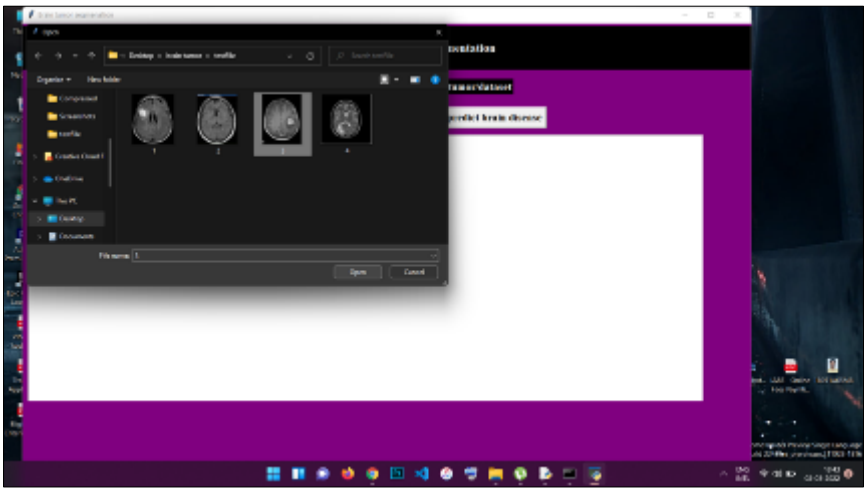

Figure 11 Execution 9

- Now we need to go to desktop > Brain tumor > test file

- The above path will be redirected to our required file and predicts the output
- The test file from the local storage will be classified as malignant or benign

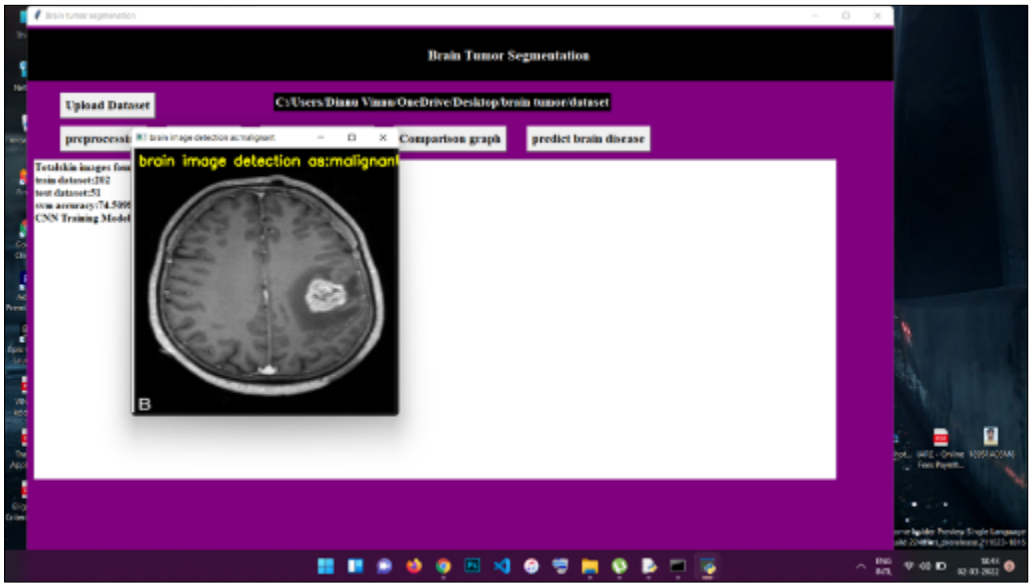

Figure 12 Execution 10

- Here the detected brain image tends to be Malignant

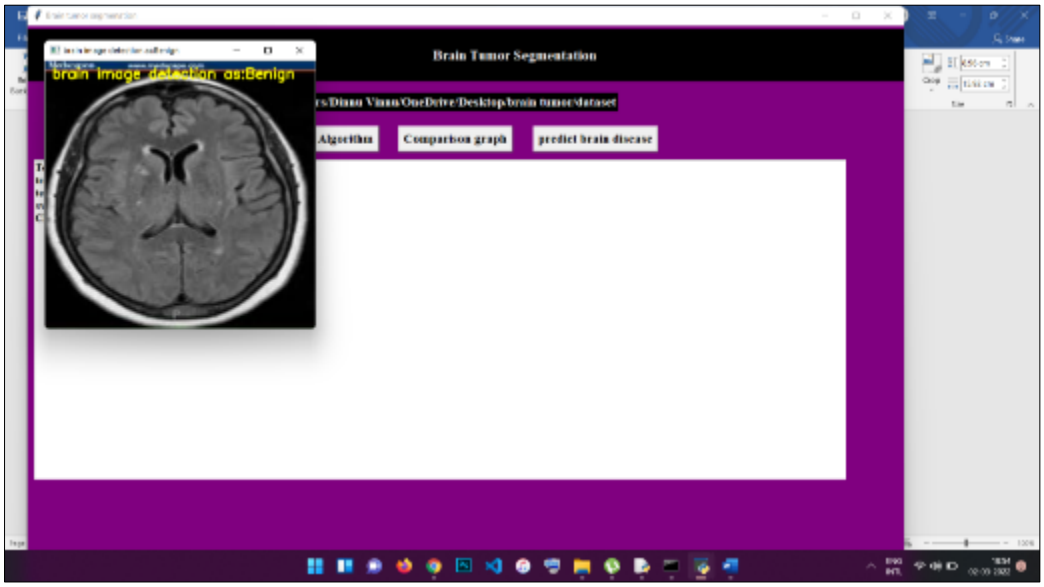

Figure 12 Execution 11

- And here it is called benign

5. Conclusion

CNN is the key algorithm among all the deep learning methods which includes the process of feed forward layers and python is used for the implementation of this project whereas image net database is for classification. Image net is one of the pre-trained models so that training has been done for only the final layer. Many features such as depth, width, height with the raw pixel value have been extracted from CNN then the function named gradient descent is applied to obtain high accuracy with very low complexity. As a result the training accuracy is 99.3%, validation accuracy is high and the validation loss is very low.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

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