

# Brain Tumor Detection using Neural Network

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## ABSTRACT

Brain Tumor is basically the unusual growth of some new cells found in the brain. This can happen in any area of the brain. Tumor are categorized by finding the origin of the cell which has tumor and if the cells are cancerous or not. Segmentation process is carried out to find if brain tumor exists or not, then the response of the patient to the tests performed is collected, different therapy sessions and also by creating models which has tumor growth in it. This one is different from the other types of tumor. Anyone can suffer from this disease. Primary tumors are basically Benign or Malignant. Here, we propose CNN (Convolutional Neural Network) based approach for improving accuracy. It also have capacity to detect certain features without any interaction from human beings.

With the help of this model it classifies whether the MRI brain scan has tumor or not. There are other different algorithms, but this paper shows that CNN gives more accuracy than the rest. This model gives validation accuracy between 77%-85%. gives more precise and accurate results. CNN also let us to train large data sets and cross validate results, hence the most easy and reliable model to use.

**KEYWORD:** Brain Tumor, Brain Detection, MRI Scan, CNN (Convolutional Neural Networks), Malignant, Benign, Accuracy, Deep Learning, Python

## INTRODUCTION

The brain is mainly has cells and different tissues in it. It is very delicate. People of any age can suffer from this. The reason or the cause of this disease is not found out by the researchers. Radiation can be one reason for brain tumor and the other is family history of tumors. Size, type and location can tell us the behavior of the tumor which is present.

According to studies different types of tumors related to brain was found out, but the two main brain tumors include Primary and Metastatic. Primary brain tumors are the ones that originate from the tissues of the brain's surroundings. Two categories of Primary tumors are glial or non-glial and benign or malignant. Malignant usually contains the cancer cells and Benign doesn't contain any cancerous, mainly cells. Tissues in the brain are mainly affected by primary brain tumor. When different sections of the brain are affected other than brain tissue, then it increases the spread of the cancerous cell in the brain. These are called as Metastatic tumor. The meaning of Malignant is simply, cancerous. It will just produce a lump in the brain. It is uncontrollable and abnormal. Benign on the other hand is non-cancerous. The cells in the tumor will be normal for this type.

Magnetic resonance imaging (MRI), widely used technique to find out whether the tumor is present or not. It helps in imaging structures of the human brain. The new technologies, especially Machine Learning and AI(Artificial Intelligence) have a major impact on medical field, with all the important support for medical branch, including mainly imaging. Image segmentation and classification are applied

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on MRI image processing to provide as a second option for the radiologists.

With the use of CNN model better accuracy is obtained. In the proposed system, the image is obtained using MRI scan. Segmentation is performed for the MR image that is obtained by the deep learning. To train the system in an efficient way data augmentation is mainly used. Finally the result is obtained by a pre-trained CNN model.

## PROBLEM DEFINITION

Tumors can occur in different ways it can be either in the brain or in the spinal cord, but the causes for these tumors are the same, also share same things in common. No one really found the actual cause for this problem where we can prevent this from occurring. Few researchers came to the conclusion that the changes that happen in the normal brain cells can be leading to this state of disease. The main effect on the patient's symptoms can be found by checking the location of the tumor.

One of the ways to find out tumor is by Imaging only after the onset of neurological symptoms. Even though the life of patient is in trouble because of brain tumors, there is no other way than imaging.

Brain tumor identification is mainly executed using MRI images. Some methods use CT images in the process, but it is identified that the outcome is not accurate when compared to the procedures that use MRI images.

Hence to overcome this we uses CNN method. The ability of CNN has been shown very effectively in areas such as image processing and classification. That is why this model uses CNN instead of KNN. Also other tests have proven that the accuracy rate that CNN gives is greater than that of KNN. This model uses CNN model to classify whether the MRI brain scan has tumor or not. By building and training a CNN

model it becomes easy to identify if a person is suffering from tumor or not. Also other tests have proven that the accuracy rate that CNN gives is greater than that of KNN. In normal neural network the images are not scalable, but with CNN it can scale images. Other methods when using large data sets will also slow down, and also difficult to understand.

## LITERATURE SURVEY

Convolutional Neural Networks (ConvNets or CNNs) are a category of Neural Networks that have proven very effective in areas such as image recognition and classification. ConvNets have been successful in identifying faces, objects and traffic signs apart from powering vision in robots. CNN can be applied on any 2D and 3D array of data.

AUTHOR	YEAR	DESCRIPTION
Dvořák et al[1]	2015	The authors designed a local prediction approach for segmentation task(3D) which systematically examines parameters which are relevant for anatomical structures.
Havaei et al[2]	2015	The authors proposed an architecture which consists of two pathways: first one focuses on the details of glimos and the second is patch wise training that allows to train models.
Pereira et al[3]	2016	Automatic segmentation was proposed by the authors here by using CNN method
Kamnitsas et al[4]	2017	Three dimensional CNN for the challenging task of brain segmentation.
Amin et al[5]	2018	The author simply uses CNN method.
Seetha et al[6]	2018	In this paper, CNN archives the rate of 97.5 accuracy that is with low complexity and when compared with the other state of art methods.
Sajjad et al[7]	2019	The authors proposed CNN method which is based on multi grade tumor classification
Deepak and Ameer[8]	2019	The proposed paper adopts the concept of deep learning and mainly uses GoogLeNet to extract features.
Özyurt et al[9]	2019	It provides high performance for classification with many different classifiers.
Saba et al[10]	2020	Here Grab cut method is used by the authors for accurate segmentation.

## PROPOSED METHOD

The proposed method mainly consists of:

### BRAIN MRI IMAGE

Magnetic resonance imaging (MRI) of head, a painless test that produces the images of the brain. It creates the images using a magnetic field and radio waves. This test is also called as Cranial MRI. MRI scan usually doesn't use radiation to produce images, hence it is very different from X-Ray and CT Scan.

### PREPROCESSING

This process helps in improving the MR images that is produced and so it is capable for further processing. It improves the parameters of the image which is produced. Here the parameters are mainly noise in the data, improvement in the appearance of MR images, unnecessary parts of image, and maintaining the relevant edges. It also helps in improving the segmentation accuracy.

### SEGMENTATION

Segmentation refers to the process of dividing or making partition of the image into different segments or regions. Every pixel in an image is allocated to one of a number of these categories. Image segmentation plays an important role in Brain Tumor Detection.

### FEATURE EXTRACTION

As reducing values for feature reduction, extraction deals with reducing amount of the resources that is required to mainly describe a large data set. Features that are in the set of data is reduced. So the aim is that the new set of reduced set of the data should be able to give a summary of the information that was contained by the original data set.

### FEATURE REDUCTION

Feature reduction is used for reducing input variable numbers. When using large values as input can lead to poor working or performance of the machine learning algorithms. The main focus of this method is to reduce the input values.

### TRAINING

This is performed to train and check if the training data fit the model. Generation of this model is to before-hand predict the unknown results which is the test set. This particular set consists of the examples which were used during the learning process. When separating the data set to a training set and also testing set, here we see that most of the data is not for the testing set but for the training set. So training set has the larger portion and smaller data portion is for testing.

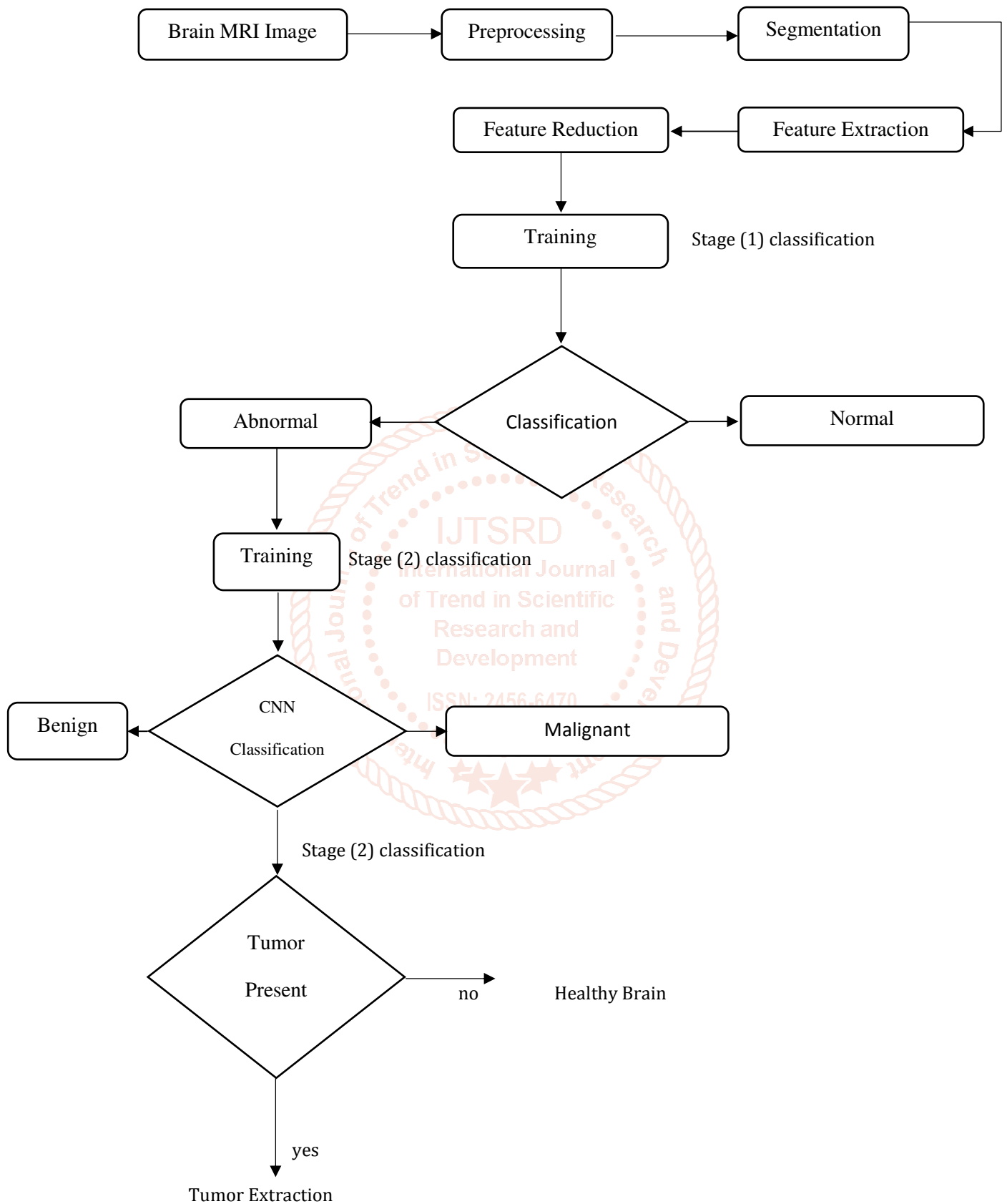
### BENIGN

These are the type of cancer cells which doesn't spread around and cause danger. When removed they don't usually grow back. They can turn out to be dangerous if not treated well.

**MALIGNANT**

Malignant is actually the cancerous cells that kills mainly the nearby tissues and can even spread to other parts of the body. It is the type which is not as dangerous as the other. It causes a lot of pain to the patient.

**FLOWCHART OF THE PROPOSED METHOD**



The above diagram simply describes how Brain Tumor is detected using Neural Network. After the Brain MRI image is obtained it goes through several steps. It first undergoes pre-processing. Pre-processing mainly focuses in the improvement of the image data that eliminates distortions. Then comes segmentation. The process of separating the tumor from normal brain tissues is called as Segmentation. After undergoing feature extraction and feature reduction it undergoes the Training method.

Next step is classification. In this step the normal ones are rejected and the abnormal ones goes through one more training method and then classified using the CNN Classification method. After this classification, a conclusion is made by differentiating the tumor into MALIGNANT and BENIGN. Benign simply means that the cells in the tumor are normal, which indicates that the brain is healthy and when the cells are abnormal, they are cancerous cell and the tumor is Malignant.

This algorithm also provides an easy architecture and there is no need of feature extraction. By building and training a CNN model it becomes easy to identify if a person is suffering from tumor or not.

The proposed model has 198 images as training set and 58 images as test sets. The datasets are then further classified into training and test sets from where tumor and non-tumor ones are identified. Single prediction is made, that is single images of brain scans are used to validate whether the model can predict correctly or not. From the training set then the images are classified based on whether the image has tumor or not. Finally in the test set, based on the images it tests the accuracy of the detection of tumor. This model has validation accuracy between 77%-85%

## RESULT

The data set which is collected contains tumor and non tumor images collected. CNN based algorithm does not require the feature extraction steps separately and that is the main benefit of this method. The feature value that is extracted is from CNN itself. Because of this the computation times is less and the accuracy is high. For this study using CNN algorithm, we receive a training accuracy between 77% to 85%. This method actually uses CNN to improve accuracy than other methods. The results contain tumor and non tumor images. Here is the output obtained by python programming, the accuracy obtained.

## FINAL OUTPUT

```
Epoch 1/25
7/7 [=====] - 1s 177ms/step - loss: 0.6556 - accuracy: 0.6769 - val_loss: 0.5644 - val_accuracy: 0.7414
Epoch 2/25
7/7 [=====] - 1s 115ms/step - loss: 0.5535 - accuracy: 0.7538 - val_loss: 0.5159 - val_accuracy: 0.8621
Epoch 3/25
7/7 [=====] - 1s 116ms/step - loss: 0.5783 - accuracy: 0.7179 - val_loss: 0.5495 - val_accuracy: 0.7931
Epoch 4/25
7/7 [=====] - 1s 113ms/step - loss: 0.5546 - accuracy: 0.7231 - val_loss: 0.5143 - val_accuracy: 0.8103
Epoch 5/25
7/7 [=====] - 1s 116ms/step - loss: 0.5395 - accuracy: 0.7333 - val_loss: 0.7424 - val_accuracy: 0.5862
Epoch 6/25
7/7 [=====] - 1s 111ms/step - loss: 0.5981 - accuracy: 0.7077 - val_loss: 0.5995 - val_accuracy: 0.7069
Epoch 7/25
7/7 [=====] - 1s 116ms/step - loss: 0.5619 - accuracy: 0.7641 - val_loss: 0.6129 - val_accuracy: 0.7241
Epoch 8/25
7/7 [=====] - 1s 113ms/step - loss: 0.5132 - accuracy: 0.7590 - val_loss: 0.4993 - val_accuracy: 0.7759
Epoch 9/25
7/7 [=====] - 1s 120ms/step - loss: 0.5202 - accuracy: 0.7590 - val_loss: 0.5274 - val_accuracy: 0.7586
Epoch 10/25
7/7 [=====] - 1s 115ms/step - loss: 0.5116 - accuracy: 0.7692 - val_loss: 0.5779 - val_accuracy: 0.7759
Epoch 11/25
7/7 [=====] - 1s 119ms/step - loss: 0.5066 - accuracy: 0.7692 - val_loss: 0.4979 - val_accuracy: 0.7759
Epoch 12/25
7/7 [=====] - 1s 112ms/step - loss: 0.4708 - accuracy: 0.7795 - val_loss: 0.5810 - val_accuracy: 0.7931
Epoch 13/25
7/7 [=====] - 1s 114ms/step - loss: 0.5122 - accuracy: 0.7282 - val_loss: 0.6496 - val_accuracy: 0.6897
Epoch 14/25
7/7 [=====] - 1s 122ms/step - loss: 0.4888 - accuracy: 0.7897 - val_loss: 0.5169 - val_accuracy: 0.7069
Epoch 15/25
7/7 [=====] - 1s 118ms/step - loss: 0.4182 - accuracy: 0.7949 - val_loss: 0.4999 - val_accuracy: 0.7241
Epoch 16/25
7/7 [=====] - 1s 123ms/step - loss: 0.4103 - accuracy: 0.8051 - val_loss: 0.6198 - val_accuracy: 0.7414
Epoch 17/25
7/7 [=====] - 1s 120ms/step - loss: 0.4481 - accuracy: 0.8000 - val_loss: 0.6796 - val_accuracy: 0.6034
Epoch 18/25
7/7 [=====] - 1s 121ms/step - loss: 0.3965 - accuracy: 0.8513 - val_loss: 0.6689 - val_accuracy: 0.6724
Epoch 19/25
7/7 [=====] - 1s 142ms/step - loss: 0.3434 - accuracy: 0.8615 - val_loss: 0.6310 - val_accuracy: 0.7414
Epoch 20/25
7/7 [=====] - 1s 125ms/step - loss: 0.3777 - accuracy: 0.8256 - val_loss: 1.1722 - val_accuracy: 0.5690
Epoch 21/25
7/7 [=====] - 1s 127ms/step - loss: 0.5587 - accuracy: 0.7282 - val_loss: 0.6997 - val_accuracy: 0.5690
Epoch 22/25
7/7 [=====] - 1s 125ms/step - loss: 0.4466 - accuracy: 0.8410 - val_loss: 0.5980 - val_accuracy: 0.6897
Epoch 23/25
7/7 [=====] - 1s 144ms/step - loss: 0.3676 - accuracy: 0.8718 - val_loss: 0.5484 - val_accuracy: 0.7241
Epoch 24/25
7/7 [=====] - 1s 134ms/step - loss: 0.3987 - accuracy: 0.8154 - val_loss: 0.5853 - val_accuracy: 0.7069
Epoch 25/25
7/7 [=====] - 1s 131ms/step - loss: 0.3309 - accuracy: 0.8615 - val_loss: 0.6889 - val_accuracy: 0.6724
no
```

## CONCLUSION AND FUTURE WORK

In this study the CNN method is used, CNN gives more accuracy than all the other algorithms. It made it easier to attain more accuracy and scalability. This paper aims to differentiate and identify, tumor and non-tumor ones based

on the training set used. By CNN classification it is done. At first the MRI Image obtained undergoes preprocessing, segmentation, feature extraction, feature reduction and then training.

In the proposed model because of CNN we were able to improve accuracy by making use of data augmentation and learning methods. The main reason why all this is done is to find tumor and also for further treatments to be done.

#### FUTURE SCOPE

1. Add more training sets to the existing ones.
2. More accuracy can be obtained
3. Scalability can be obtained

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