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# A Review on Different Brain Tumour Detection Techniques

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**Abstract:** *Brain tumor detection is a critical aspect of modern healthcare, as early diagnosis and accurate localization are vital for effective treatment and patient outcomes. Deep learning techniques have shown remarkable potential in addressing this challenge. This study presents a novel approach for brain tumor detection using deep learning mechanism. We employ a convolutional neural network (CNN) architecture that is tailored to analyze medical images, specifically magnetic resonance imaging (MRI) scans. The model is trained on a large dataset of annotated MRI images, enabling it to learn intricate patterns and features indicative of brain tumors. The CNN's multi-layered structure enables it to automatically extract relevant features, minimizing the need for handcrafted feature engineering. Results demonstrate the effectiveness of the proposed approach, achieving high accuracy and sensitivity in brain tumor detection. This approach not only aids in early diagnosis but also offers the potential for real-time detection and localization, contributing to improved treatment planning. The use of deep learning in brain tumor detection holds promise for enhancing healthcare outcomes and reducing the burden on radiologists, paving the way for more efficient and accurate diagnosis and treatment of brain tumors.*

**Keywords:** Brain tumor detection, Deep learning, Convolutional neural network (CNN), Medical images, Healthcare, Magnetic resonance imaging (MRI)

## I. INTRODUCTION

A. Brain: The brain is largest and most complex organ in human body that serves as the center of the nervous system [6]. It is located in the head usually it is close to the sensory organ for senses such as vision. B. Tumor: A tumor is tissue that is growing where it should not be. Another name of tumor is neoplasm [6]. A tumor is usually form as lump or mass. Tumors are either malignant(harmful) or benign(safe) tumors. Cancer for examples is malignant and sometime spreads to other places on body. Tumor can occur in many different parts of the brain, and it may be classified as primary tumor or secondary tumor.

C. Brain Tumor: A brain tumor occurs when abnormal cells from within the body. There are main two types of tumors malignant(cancerous) and benign (non-cancerous) [6]. The Cancerous or malignant tumors are divided into primary tumors, which starts within the brain, and the secondary tumors, which have spread from elsewhere, known as brain metastasis tumors. All types of brain tumors may produce more than one symptom that vary depending on the part of brain involved. These symptoms may include headaches, seizures, problems with vision, vomiting and mental changes.

D. Deep Learning: Deep Learning is specialized form of machine learning. Deep learning is an Artificial Intelligence function. In deep learning, classification can be performed directly from a dataset of images, sound or text. It can achieve excellent accuracy as compared to human performance. Deep learning model needs large amount of labelled data and many layered neural network architecture. Deep learning uses many neural network layers for advanced feature recognition and prediction. So, it is also called as deep neural learning or deep neural network. The deep neural network (DNN) is an artificial neural network (ANN) with multiple layers between the input and output layers each mathematical manipulation as such is considered a layer, and complex DNN structure have many layers, hence the name “deep” networks. DNN can model complex non-linear relationships. The applications of deep learning are cancer detection and speech translation. [4] A brain tumor is an abnormal growth of cells within the brain. Brain tumors include the tumors inside cranium or/and in the central spinal canal. Normally in our body, new cells are produced which replace the old and damaged cells in a controlled manner. But in case of brain tumors, tumor cells go on

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multiplying uncontrollably [2]. As per the National Brain Tumor Society nearly 70,000 people in United States are suffering from primary brain tumor. Brain tumor is ranked as 10th most common tumor in India in 2021 [7].

Brain tumor is also referred to as intracranial neoplasm. The two types of tumors are malignant and benign tumors. Standard MRI sequences are generally used to differentiate between different types of brain tumors based on visual qualities and contrast texture analysis of the soft tissue. More than 120 classes of brain tumors are known to be classified in four levels according to the level malignancy by the World Health Organization (WHO). [3] As the skull protects the brain, brain tumor detection at an early stage is only possible when a diagnostic tool is directed at the intracranial cavity. The presence of tumor is noticed by the Magnetic Resonance Imaging [MRI] scanning. Even in the MRI image of a brain tumor, the edges of tumor are not sharp, hence the segmentation results are not accurate, i.e. the segmentation may be over-segmented or under-segmented. This may happen at the initial stage of the tumors. So, the main objective of the proposed work is to get an enhanced form of the tumor image by applying different methods. [1]

## II. LITERATURE REVIEW & RELATED WORK

Gao et al. [5] studies for the Alzheimer's disease early detection, this disease destroys the mentalfunction of the brain. They have used two CNN models, 2D and 3D, and these models were trained by using the 2D and 3D Computerized Tomography images and the result is declared b combining the output of these two models. Some kind of Similar technology used in brain tumor detection.

(Bangio, T. et al. (2014). Representation Learning: A Review and New Perspectives. IEEE Transactions on Pattern Analysis and Machine Intelligence. 36 (9): 1698–1728.) [6]

There is a very large group of people, whose exact numbers are unknown but they continue to increase, who are diagnosed with a type of brain tumors called secondary brain tumor. Early detection is always likely to accelerate the process of controlling and eliminating the tumor at early stages, with the help of highly efficient clinical imaging devices. Meanwhile, patients who suffer from brain tumors face the problem of MRI machines inability to precisely detect and classify the brain tumor, which could lead to physical complications that cause disability [6].

Sneha Grampurohit, VenkammaShalavadi, Vaishnavi R. Dhotargavi, MeghaKudari, Mrs Soumya Jolad "BRAIN TUMOR DETECTION USING DEEP LEARNING MODELS" 2020 IEEE India Council International Subsections Conference (INDISCON) [7]

A brain tumor is a disease caused due to the abnormal growth of mass in the brain. Normally in our body, new cells are produced which replace the old and damaged cells in a controlled manner. But in case of brain tumor, tumor cells go on multiplying uncontrollably. As per the National Brain Tumor Society nearly 70,000 people in United States are suffering from primary brain tumor. Brain tumor is ranked as 10th most common tumor in India. The presence of tumor is noticed by the Magnetic Resonance Imaging [MRI] scanning. The MRI scanning should be diagnosed by the physician and later based on the results; the treatments shall be started. This procedure can be a little time consuming. [3]

Minu Samantaray, MilleePanigrahi, K.C. Patra, Avipsa S. Panda, Rina Mahakud "An adaptive filtering technique for brain tumor analysis and detection" [5]

Brain tumor detection in an early stage is a difficult task, as the imaging is quite unclear. The necessity of automated brain tumor segmentation and detection is high. To obtain an accurate MRI image of the brain tumor is challenging. An MRI image has high contrast images indicating regular and irregular tissues that help in differentiating the overlap margins. But in case of an early brain tumor, the edges of the image are not sharp which causes the segmentation results to be inaccurate, i.e. the segmentation may be over-segmented or under-segmented. This may happen at the initial stage of the tumors. So, the main objective of the proposed work is to get an enhanced form of the tumor image by applying different methods, including filtering by using deep learning [6].

### 2.1 Proposed Work

Magnetic Resonance Imaging (MRI) has become an effective tool for clinical research in recent years and has found itself in applications such as brain tumor detection.Deep learning techniques when applied on these MRI images helps to detect the tumor.We have implemented two techniques such as CNN and depth wise separable method on the MRI image dataset.Experimental results shows that depthwise separable CNN gives better accuracy as compared to CNN.

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The accuracy was found out to be 92% for the test set using Depthwise Separable CNN. The system will be definitely helpful in the healthcare domain [8, 9, 11].

## III. METHODOLOGY

The proposed system has mainly five modules. Dataset, Pre-processing, Split the data, Build CNN model train Deep Neural network for epochs, and classification. In dataset we can take multiple MRI images and take one as input image. In preprocessing image to encoded the label and resize the image. In split the data we set the image as 80% Training Data and 20% Testing Data

The system will have mainly five modules.

- Dataset: In dataset we can take multiple MRI images and take one as input image
- Pre-processing: In pre-processing image to encoded the label and resize the image.
- Split the data: In split the data we set the image as Training Data and Testing Data.
- Build CNN model: To train Deep Neural network for classification.
- Classification: Used to classify the Brain tumor

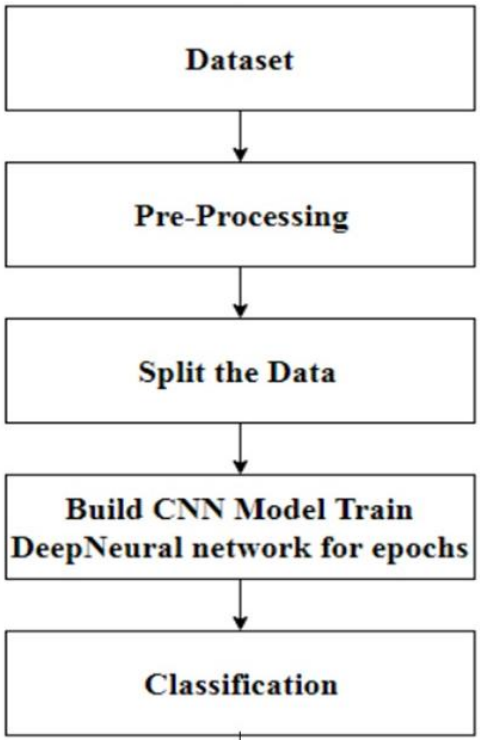


Fig 1. Diagram of Proposed Architecture

The dataset used for training and testing was collected from Kaggle[12] . It contains 3264 brain MRI images in total. 2764 of them are images containing tumor (tumorous images) and 500 images are normal (without tumor). Tumorous images are segregated in folder named “tumor” and normal images are kept in “no tumor” folder.

The images are in different formats and of variable sizes. As mentioned the dataset contains images of different formats and sizes which may contain noise. This can lead to errors in classification and segmentation. Pre-processing the image will definitely reduce this problem and data can be transformed in a standard format acceptable for classification and segmentation. Images are converted into greyscale format with a fixed size of 0x256 pixel. Gausian blur is applied on the images to reduce noise. Further the images are passed through high pass filter which will sharpen the image, so that more intricate features can be extracted.

Deep Learning requires large dataset for producing accurate results. Image augmentation is a process of increasing size of the dataset by producing copies of images through different ways of processing like random rotation, shifts, shear

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and flips. 1) Architecture for tumor detection: The pre-processed image is fed to the CNN model which has a input layer,convolution layers and a fully connected layer which activates a specific neutron to give specific output or decision. The input image forms the input layer. The image is represented as a 256x256 pixel matrix. Each pixel reveals certain features. In the first convolution layer 8 filters of 3x3 size kernels each are applied over the input image by sliding through the position one by one and in total 8 feature maps are produced, this process is called feature extraction. These features are then fed to ReLU activation function which performs a threshold operation to each input element where values less than zero are set to zero. A max pooling layer of 2x2 window size is applied to the output of ReLU layer which results into down-sampling the feature maps into 128x128 pixel size. The output of previous convolution layer serves as input to second convolution layer. Second convolution layer consists of 12 filters of 3x3 size kernels which are applied to each of the 8 features maps obtained from previous layer. Similar ReLU and max pooling operations are performed to produce down-sampled data of 64x64 pixel. Same operations are continued for the third convolution layer where 24 filters of 3x3 size kernels are used. AgainReLU operation is applied and fed to the max pooling layer which produces 32x32 pixel data. The operations performed throughout the three layers extracts prominent and important features necessary for accurate classification. The output of the third convolutional layer is 24 features maps of 32x32 pixels each. These are then flattened to a single vector of length 32 x 32 x 24 = 24576, which is used as the input to a fully-connected layer with 106 neurons (or elements). This feeds into another fully-connected layer with 2 neurons, one for each of the classes, which is used to determine the class of the image, that is, tumorous or non-tumorous.

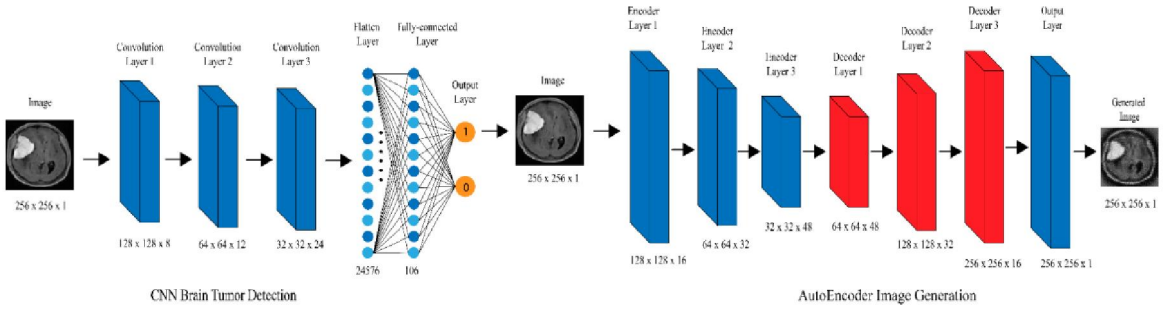


Fig 1. Proposed architecture

### 3.1 Objectives

The motivation behind this study is to detect brain tumor and provide better treatment for the sufferings. The abnormal growths of cells in the brain are called tumors and cancer is a term used to represent malignant tumors. Usually, CT or MRI scans are used for the detection of cancer regions in the brain. Positron Emission Tomography, Cerebral Arteriogram, Lumbar Puncture, Molecular testing is also used for brain tumor detection. In this study, MRI scan images are taken to analyze the disease condition. Objective of this project is i) identify the abnormal image ii) segment tumor region. Density of the tumor can be estimated from the segmented mask and it will help in therapy. Deep learning technique is employed to detect abnormality from MRI images. Multi-level thresholding is applied to segment the tumor region. Number of malignant pixels gives the density of the affected region. [3] Brain tumor at early stage is very difficult task for doctors to identify. MRI images are more prone to noise and other environmental interference. So, it becomes difficult for doctors to identify tumor and their causes. So here we come up with the system, where system will detect brain tumor from images. Here we convert image into grayscale image. We apply filter to image to remove noise and other environmental interference from image. User has to select the image. System will process the image by applying image processing steps. We applied a unique algorithm to detect tumor from brain image. But edges of the image are not sharp in early stage of brain tumor. So, we apply image segmentation on image to detect edges of the images. In this method we applied image segmentation to detect tumor. Here we proposed image segmentation process and many image filtering techniques for accuracy.

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## IV. CONCLUSION

The application of deep learning in brain tumor detection represents a transformative paradigm shift in healthcare. Through the utilization of advanced algorithms and computational techniques, deep learning offers unparalleled potential to revolutionize the diagnosis and treatment of brain tumors. With its ability to extract intricate patterns and features from medical imaging data, deep learning has shown remarkable accuracy and efficiency in identifying tumors with speed and precision. Moreover, the integration of multiple imaging modalities and the development of personalized diagnostic models hold promise for enhancing the specificity and sensitivity of tumor detection, thereby improving patient outcomes.

In our study, we utilized a dataset of Brain MRI images and applied four Convolutional Neural Network (CNN) models for the task of classifying the scans into four different classes: Glioma, Meningioma, No tumor, and Pituitary. The purpose was to evaluate the performance of these models in accurately identifying brain tumor.

In conclusion, the future of brain tumor detection using deep learning holds immense promise for transforming healthcare delivery and improving patient outcomes. Through ongoing collaboration, innovation, and ethical stewardship, we can harness the full potential of deep learning to combat brain tumors effectively and positively impact the lives of patients worldwide.

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