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BRAIN CANCER DETECTION WEB APPLICATION

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Abstract :- A brain tumor is the growth of atypical cells in the brain, which may also result in a deadly disease known as cancer. An early diagnosis of a brain tumor is very difficult due to the sensitivity of MRI images to noise and environmental factors. The main reason for brain tumors is the aborted progression of brain cells. Many health organizations have already recognized the brain tumor as the second controversial causing many human deaths in the world. A brain tumor can recognize a variety of signs which include seizures, temper changing, trouble in strolling and hearing, vision, muscular motion, etc. A brain tumor can identify several symptoms including seizures, mood changes, difficulty in walking and hearing, vision, and muscular movement, etc. brain tumor is classified into Gliomas, medulloblastoma, ependymomas, CNS lymphoma, and oligodendroglioma. In the primary stage, the tumor can be removed but in the secondary stage, the tumor disease spreads, due to this after removal of the tumor the seldom remains and grow back again so this is the biggest problem in the secondary stage of the tumor. It is very important to detect brain tumors as early as possible. Proper treatment planning and accurate diagnostics are the top priorities to improve life expectancy. Magnetic Resonance Imaging is the best method to detect brain tumors. An automated brain tumor detection system is needed to detect tumors at their earliest stage due to the complexity of brain tumors and their properties. The manual examination can be error-prone due to the complexities involved in detecting tumors. We employ a Deep Learning based Separable Convolution Neural Network to detect the tumor from the MRI images. Several successful algorithms are reviewed in this paper after studying a number of relevant research papers. The methods in most studies include pre-processing brain images, segmenting them, extracting features, clustering, and detecting tumors. According to the World Health Organization and the American Brain Tumor Association, the most common classification system uses a grade I to IV scale to classify benign and malignant tumor types. On this scale, benign tumors fall into grade I and II gliomas and malignant tumors fall into grade III and IV gliomas. Grade I and II glioma is also called a low-grade type of tumor and its growth is slow, while grades III and IV are called high-grade tumor types and possess rapid tumor growth. If the low-grade brain tumor is left untreated, it is likely to develop into a high-grade brain tumor which is a malignant brain tumor. Patients with grade II gliomas require serial monitoring and observations by magnetic resonance imaging (MRI) or computed tomography (CT) every 6 to 12 months. A brain tumor can affect any individual at any age, and its impact on the body may not be the same for each individual.

***Keywords* - Brain Tumor Detection, MRI images, Convolution Neural Network (CNN), Deep Learning (DL), Image Processing, Algorithms**.

I. INTRODUCTION

In the human body, the brain is the most important organ which controls the functions of other organs and helps in decision-making [3]. An abnormal growth of cells within the brain causes a brain tumor. Tumors tend to repeat themselves and spread over the brain's surface. A medical imaging technique called magnetic resonance imaging (MRI) is one of the most common methods for identifying and locating tumors in the brain. Deep learning is a robust and better approach in machine learning in many fields, such as medical imaging.

It is mainly the control center of the central nervous system and it is responsible for performing the voluntary and involuntary daily activities in the human body. A tumor is fibrous tissue of unwanted growth tissue in our brain that proliferates unconstrained [3]. The result of the analysis performed in this paper reveals whether the brain is normal or diseased by applying deep learning techniques. In this article, ANN and CNN are used in the classification of normal and tumor brains. ANN (Artificial Neural Network) works like a nervous system of the human brain, based on this a digital computer is connected to a large number of interconnections and networks that allow the neural network to train with the use of simple processing applied units on the training set and stores experiential knowledge. It has several layers of neurons that are interconnected. The neural network can acquire knowledge by using data set applied to the learning process. There will be an input and output layer while there could be any number of hidden layers. In the learning process, weights and distortion are added to the neurons of each layer based on the input characteristics and the previous layers (for hidden layers and output layers). Because ANN works with fully linked layers, which requires more processing, and because an image is employed as the input in this paper, it focuses on applying CNN as well. In CNN (Convolutional Neural Network) convolutional is the name of mathematical linear equation [3]. A model is trained based on the activation function applied to the input features and on the hidden layers where more learning takes place to get the expected output.

[1] By passing each MRI image through an imaging chain, the image is pre-processed to remove noise and is further enhanced to improve image contrast. This paper proposes two different techniques which are then applied to the image to extract the tumor. These segmentation techniques consist of SOM Clustering and SVM Classification. The application of each of the segmentation techniques makes it possible to determine the most appropriate method for segmenting the tumor from each of the images. Foreground points are extracted using the ginput() command from a texture image. The rangefit() method is applied to generate the texture image. To improve the texture characteristics of the image, a smoothing filter is applied to the texture image. In this project, the main challenge was to identify and extract the proper tumor region from the image. Due to various lighting issues, there were unnecessary white parts in the image that could be mistakenly segmented like a tumor. Unwanted noise and reduced contrast also show different image regions that are falsely declared as a tumor [1]. Another challenge faced was the degraded quality of the MRI image due to several problems that would have occurred during the acquisition stage.

The term "brain tumor" refers to a tumor that has spread to any part of the brain. There are two stages of brain tumor –

1) Primary stage
2) Secondary stage

Tumors in the primary stage can be removed, but in the second stage, the disease can spread, so after removal, the tumor rarely remains and grows back again, so this is the biggest problem with secondary stage tumors. This happens due to the inaccurate location of the tumor area. The next step concerns detection techniques. As soon as any segmentation and detection techniques are applied to brain tumors, the imaging of the tumors can be done in the following manner: a) MRI scanning that is magnetic resonant image b) CT scanning i.e computer tomography c) Ultrasound, etc. There are numerous methods for detecting a brain tumor, and we can identify and detect them more simply using these methods. Nuclear network algorithm, watershed, edge detection, fuzzy c mean algorithm, and asymmetry of the brain are some of the edges. The edge detection task is one of the most attractive tasks in image processing due to its different applications. Candy-edge detection is one of the most useful features in image segmentation. It is used for the extraction of edges. F-transform is an intelligent method to handle uncertain information. This is useful for the detection of tumor boundaries [2].

The rest of the paper is organized as follows: Section II presents the literature survey, Section III presents the methodology, Section IV presents the conclusion, and finally contains the references.

II. LITERATURE SURVEY

Medical image segmentation plays an important role in the analysis of tumors from magnetic resonance imaging (MRI). A brain cancer detection and classification system with the use of ANN have been developed in this article. An assessment and findings of a number of the current researches are provided here. Convolution neural networks use organic fashions to categorize tumors. Swapnil R. Telrandhe, et. al [1] to proposed tumor detection in which segmentation separates an image into parts of regions or objects. In this, it needs to segment the background element to properly scan the image and classify the image content strictly. In this context, edge detection is an essential tool for image segmentation. This article has attempted to investigate the performance of the most commonly used edge detection techniques for image segmentation and additionally the comparison of these techniques was carried out with an experiment.

Rajeshwari G tayade, et. al [1] in their paper, gave a mixture of wavelet statistical features and co-occurrence wavelet texture feature obtained from A separate redesign of the two-tier rifle was used to organize abnormal brain issues into benign and malignant. The planned system consisted of four phases: ROI segmentation, separate ripple decay, feature abstraction, feature selection, organization, and analysis. The Support Vector Machine (SVM) was used for tumor segmentation. A pool of WST and WCT was used for the extraction of features of the neoplastic region extracted from the remodeling of the second-level split corrugation. The genetic algorithm was used to choose the best texture options from the well-extracted set of options. The method applied in this article is based on Hough's grade, a strategy that allows fully automatic localization and segmentation of the anatomy of interest. He also used a segmentation method based on a robust, multi-region, flexible, and easily adaptable learning technique for different modalities. Different amounts of training data and different dimensions of the data (2D, 2.5D, and 3D) are applied in the prediction of the final results. Convolutional neural networks, Hough voting with CNN, Voxel-wise classification, and Efficient patch-wise evaluation through CNN are used in analyzing the image. The Convolutional Neural Network (CNN) was implemented, which drives an overall accuracy of 91.3% and a recall of 88%, 81%, and 99% in the detection of meningioma, glioma, and pituitary tumor respectively. Deep learning architecture by leveraging 2D convolutional neural networks for the classification of the different types of brain tumors from MRI image slices. In this paper techniques like data acquisition, data preprocessing, pre-model, model optimization, and hyperparameter tuning are applied. Moreover, the 10-fold cross-validation was performed on the complete dataset to check for the generalizability of the model.

Preliminary results show that our approach obtained good segmentation results. This approach also reduces a large number of calculations. A region-growing algorithmic program was then used to isolate the tumor region. Preliminary results show that our approach obtained good segmentation results. Future work may involve the associated investigation of the automatic 3D neoplasm segmentation strategy, the segmentation of the return on investment is in alternative medical images, again due to the importance of forced technique in medical image retrieval.

III. REQUIREMENT

1. Python:
Python was the preferred language for this project. Python as a language has a huge community behind it. Python has an abundance of powerful tools prepared for scientific computing Packages like NumPy, Pandas, and SciPy area units are freely available and well documented. Packages like these will dramatically scale back, and change the code required to write a given program. This makes iteration fast. However, Python is not without its errors.

2. Jupiter Notebook:
Jupiter Notebook is an open-source web application that lets you create and share documents containing live code, equations, visualizations, and narrative text. Uses include data cleaning and processing, numerical simulation, statistical modeling, data visualization, machine learning, and more.

3. Noise removal and sharpening:
Unwanted data of elements are removed using the filter and the image can be sharpened and the black and white gray scale image is used as input.

4. Erosion and Dilation:
It is applied to binary image, but there are many versions for it to work on grayscale images. The basic operator effect on a binary image is the erosion of region boundaries for basic pixels.

5. Negation:
A negative is an image, usually used on a transparent band or sheet of transparent plastic film, on the negative side, the lightest areas of the photographed subject appear darkest and the darkest areas appear lightest.

6. Subtraction:
The image subtraction process is the numerical value of a pixel or the entire image is subtracted from another image. The white part of the tumor can be subtracted from another remaining part which is the black part of the images.

7. Threshold:
This is an image segmentation process which converts the grayscale image into the binary image.

8. Contour detection:
The total area or boundary can be formed correctly using the boundary detection method. The white part of tumor tissues can be highlighted and the different images and reducing the noisy details thereby bringing the tumor in focus. Different variants of the images were created using image augmentation techniques which augmented the images and internally created more images for the model. It is a useful method for calculating the size and shape occupied by tumor tissues.

IV. METHODOLOGY

The proposed methodology for this particular project, we have described our objective in two parts, the first half deals with the detection of the brain tumor or the presence of the tumor in the magnetic resonance imaging provided. The other part which is the second part contains the classification of the tumor. Here, we will analyze the MRI images which will conclude the tumor as normal and abnormal. The first segmented tumor model uses FCM and is classified by automatic learning algorithms, depending on the model focused on deep learning for tumor detection. The FCM segmentation offers a better result for the noisy cluster dataset. Although it takes a longer execution time, it keeps more information. Both ANN and CNN techniques are applied to the brain tumor dataset and their performance in image classification is analyzed. The ANN model used here has seven layers. The first layer is the flattened layer which converts the 256x256x3 images into a one-dimensional array. The next five layers are the dense layers which have the activation function as ReLU and the number of neurons in each layer is 128,256,512,256 and 128 respectively [6]. These five layers act as the hidden layers and the last dense layer that the activation function is sigmoid is the output layer with 1 neuron representing the two classes. The model is compiled with the Adam optimization technique and the binary cross-entropy loss function. With the help of training and validation images, the model is generated and trained. After the model is trained, it is tested using the set of test images. Next, the same dataset is passed to the CNN technique.

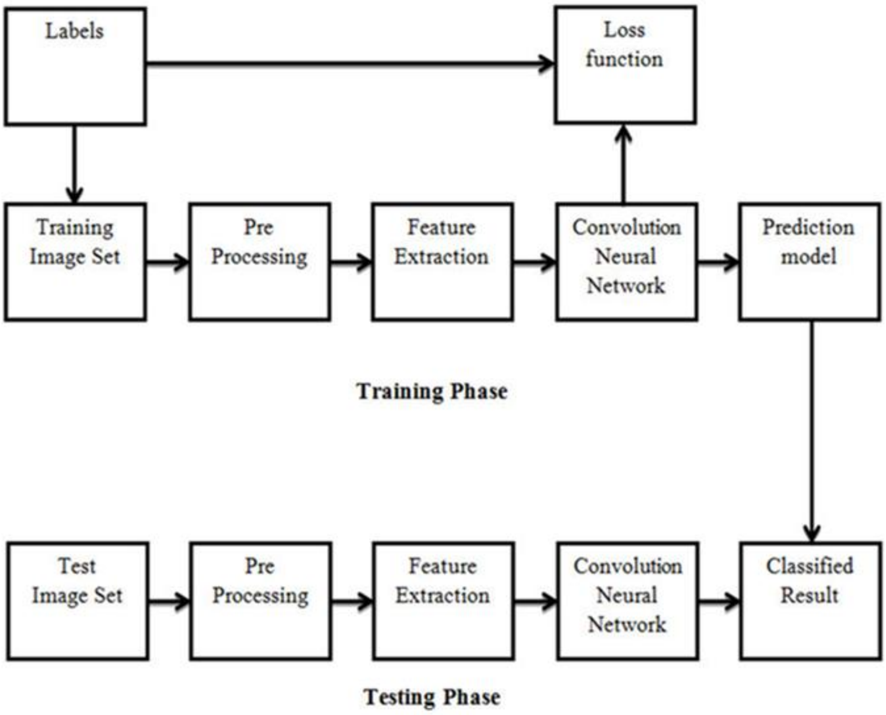


fig.1. block diagram of proposed brain tumor classification using cnn

CNN's sequential model is generated by implementing multiple layers. The input image is reformed to 256x256. The convolution layer is applied to the input image with the ReLU as the activation function, similarly, filling it means the output images look like the input image and the number of filters is 32, 32, 64, 128, 256 for different convolution levels. The max-pooling applied with the 2x2 window size and dropout function is called with 20% of dropout [6]. The Flatten method is applied to convert functions into a one-dimensional array. The fully connected layer is done by calling the dense method with the number of units as 256 and ReLU as the activation function. The output layer has 1 unit to represent the two classes and the sigmoid as an activation function.

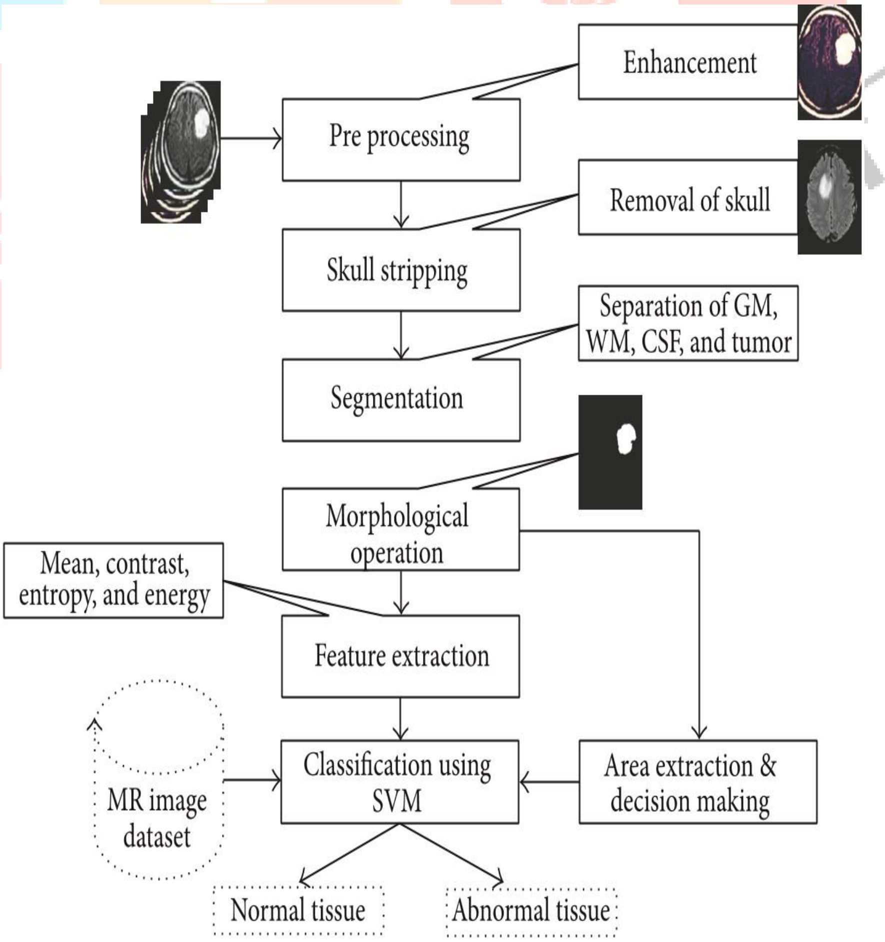


fig.2. overall flow of the brain tumor detection system

A. Data Acquisition:

This is the first step of the proposed system. In this, the data is provided that is the magnetic resonance images (MRI) that are being collected are grouped into two kinds-normal brain images and abnormal brain images. The resulting MRI images may not be of very good quality for analysis. Images can be noisy, blurry, low-contrast [8]. We used file operations such as fopen(), fclose() to read the MRI images available in Matlab. Here, the grayscale MRI images are provided as input to the system.

B. Image Pre-processing:

This is the initial processing of data in order to prepare them for primary processing or further analysis. The pre-processing phase of our project mainly includes those operations that are usually necessary before the target analysis and extraction of the necessary data and usually geometric corrections of the original image [8]. These improvements include correcting information for jaggedness and unwanted noise in an area, removing an image of a non-brain element, and transforming the data so that it reflects correctly in the original image [8]. The first preprocessing step is to transform this input MRI image into a suitable form with which further work can be done.

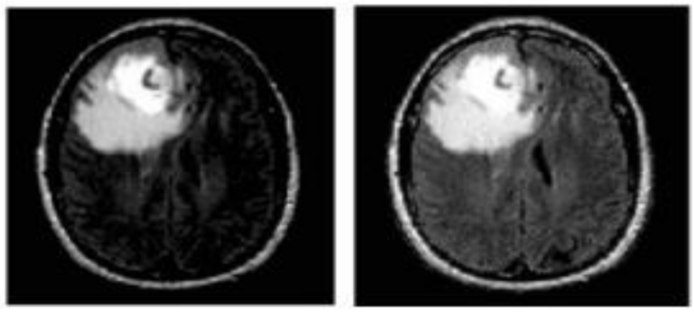


fig.3. raw image and preprocessed image

C. Skull Stripping:

Skull stripping is an important process in biomedical image analysis and is necessary for effective examination of brain tumor from MRI images. Skull stripping is the process of removing all non-brain tissue in brain images. By skull stripping, it is possible to remove additional cerebral tissues such as fat, skin, and skull in the brain images [7]. Several techniques are available for skull stripping; some of the popular techniques are automatic skull stripping using the image contour, skull skinning based on segmentation and morphological operation and skull skinning based on histogram analysis or threshold value.

D. Image Segmentation:

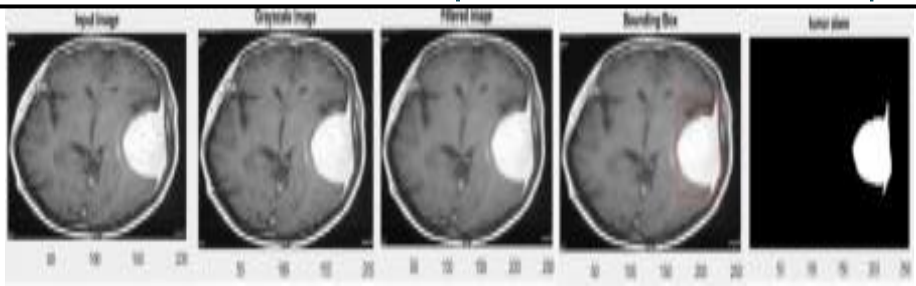
Segmentation is the most important step to correctly analyze the image because it affects the accuracy of the following steps. Due to the wide variety of lesion shapes, sizes, and colors as well as different skin types and textures proper segmentation is difficult. Additionally, some lesions have jagged edges and in some cases, there is a smooth transition between the lesion and the skin. We can solve the problem using several algorithms. They can be broadly classified as- A) Threshold method: As the name suggests, voxels above a threshold are classified as belonging to the tumor. B) Edge-based method: Intensity changes between voxel edges are used as tumor boundaries. C)Region-based method: In segmentation, a seed voxel is introduced; from this seed, similar voxels are classified as belonging to the tumor.

E. Watershed Algorithm:

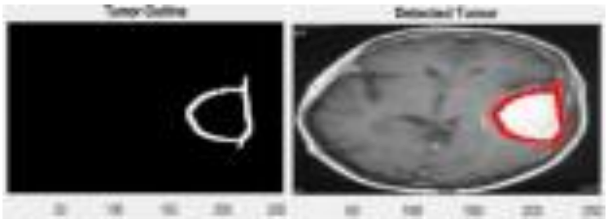
This is a unique segmentation method in which the intensities or gradients of a voxel are represented by a topographical map similar to those seen in geography. Based on the "steepness" of the map, a limit is assigned.

F. Feature Extraction:

In the feature extraction process, we can implement the efficient texture operator that labels pixels of an image. This process is used for edge detection of the images. Here, we extract features and characteristics from images to aid in the detection of brain tumors. These features include smoothness, entropy, variance, kurtosis, skewness, idm, correlation, homogeneity, mean and standard deviation [1]. Below in the figure 4 there is output result of an MRI image up till the feature extraction phase of the project.



(a) (b) (c) (d) (e)



(f) (g)

fig.4. (a)input image, (b)grayscale image, (c)filtered image, (d)bounding box, (e)tumor alone image, (f)tumor outline, (g)detected tumor.

G. Classification using CNN:

In the classification stage, a Convolutional neural networks algorithm is used for the classification of brain images. Classification and regression both can be performed with the help of this non-parametric method. We tried to invent a specimen that can accurately classify MRI image cancer with a 3D brain. A fully connected neural network can detect cancer, but because of the sharing of parameters and the connection shortage, we adopted CNN for our model.

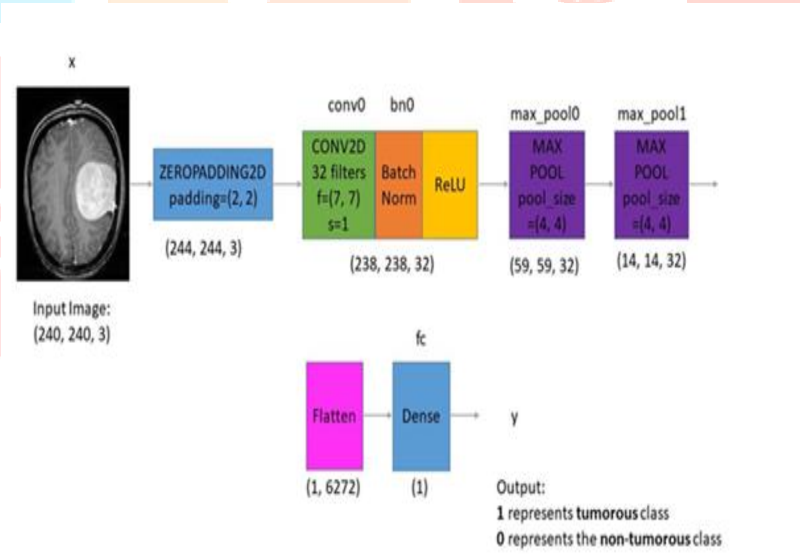


fig.5. convolutional neural network architecture

V. DATASET

The dataset has 506 images with different types of tumor and also includes images that have tissues of Fat or water.

1. DICOM Samples Image Sets, http://www.osirixviewer.com/.

2.“Brainweb:SimulatedBrainDatabase,” http://brainweb.bic.mni.mcgill.ca/cgi/brainweb1.

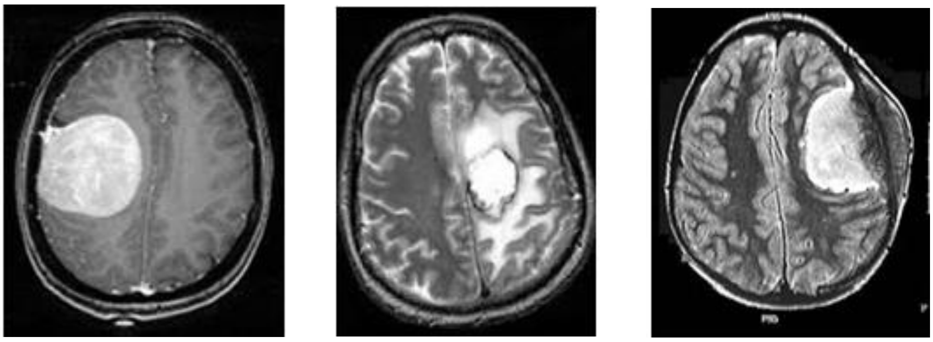


fig.6(a) sample MRI images with brain tumor

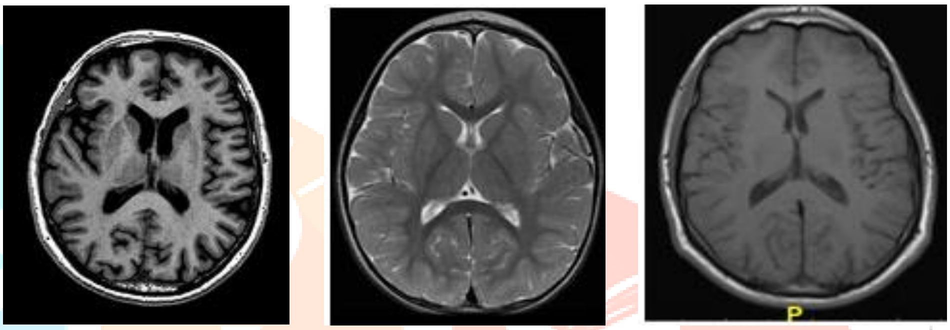


fig.6(b) sample MRI images without brain tumor

This dataset contains MRI images of brain tumors. There are two folders, one represents the normal brain image and the other represents the tumor images. There are 506 tumor images in both these folders and the subset contained 250 images. The figure 6 shows the image of the normal and brain tumor sample. A total of 206 tumor images and 200 non-tumor images are acquired. All 206 non-tumor images from another dataset were used. The images are of different shapes (eg.630X630, 225X225) and these images are resized to 256x256 pixels.

VI. WORKING

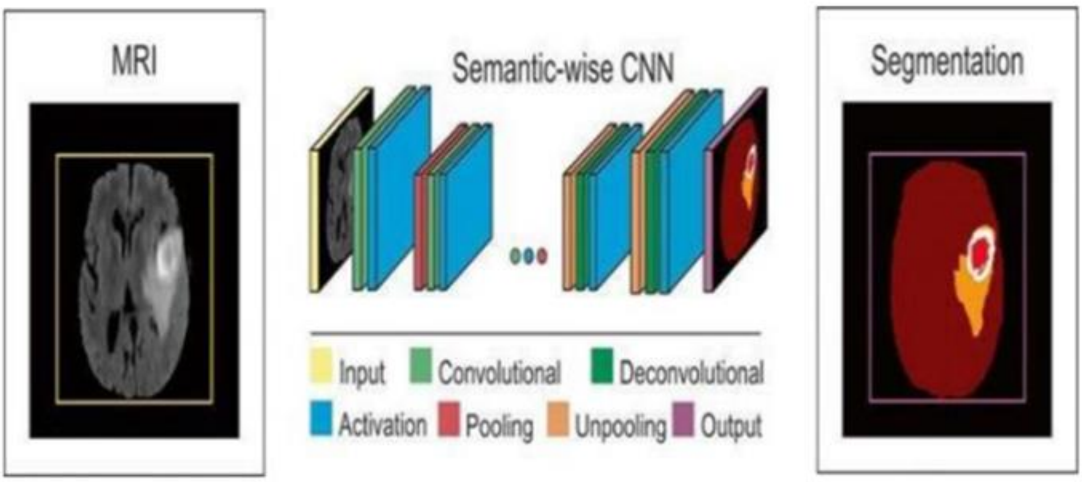


fig.7. working of CNN model for brain tumor detection

➢ The layer of CNN model:

i. Convolution 2D

ii. MAX Pooling2D

iii. Dropout

iv. Flatten

v. Dense

vi. Activation

➢ ***Convolution 2D:*** In Convolution 2D, the features are extracted from the input image. The input image is convolved with the kernel matrix (dot product operation) or filter and the result is scalar. The filter is moved along the input image to achieve repeated convolution and then provides an output matrix called a feature map.

➢ ***Max pooling 2D:*** In the Max pooling 2D, it takes the largest element from a rectified feature map.

➢***Dropout:*** Dropout is a method whereby nodes are temporarily 'dropped' in the convolutional neural network in order to produce imprecision within the dataset.

➢ ***Flatten:*** The network is then flattened by the feature map into a column for input into the neural network. It produces data in list form.

➢ ***Dense:*** The image is approximated using a linear function. It only provides a rough approximation of the actual image. The non-linearity within the dataset can be approximated with the help of a rectifier.

➢ ***Activation:*** It uses the Sigmoid function and predict the probability 0 and 1.

➢ We used Adam optimizer in compile model.

Adam: Adaptive moment estimation is used for non-convex optimization problem like straightforward to implement.

VGG-16 Model

A convolutional neural network is a deep learning algorithm that accepts an input image, it assigns characteristics to different aspects of the image and can classify this image. The pre-processing required in the convolution network is much less than in other classification problems. VGG16 is one such type of convolutional neural network. It is 16 layers deep making the model heavier could increase the training time i.e.input images are processed at 16 levels. In this model, production is classified into several categories. For example, suppose a VGG16 network receives input images of 100 different objects, then the network classifies them images based on requirements such as presence/absence of tumor, classification of objects in photographs, etc. This model was proposed by K Simonyan and A Zisserman and reached 92.7% accuracy in the top 5 test accuracy in ImageNet Database. For the brain cancer detection project, the image set of MRI scans is taken into consideration and it is classifying different images based on whether the tumor is present or not.

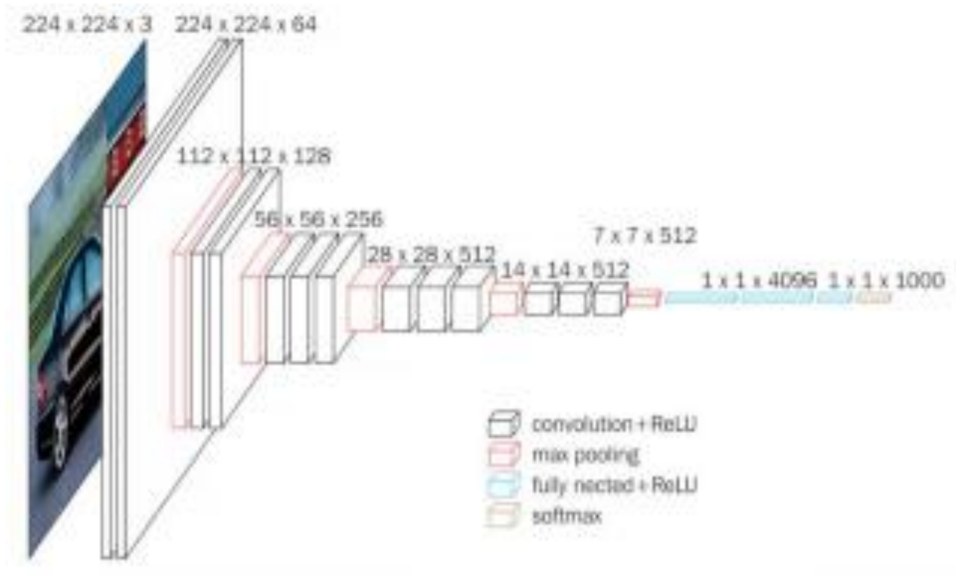


fig.8. vgg-16 model

VII. CONCLUSION

In this paper, we proposed several techniques to detect and segment a brain tumor from MRI images. To extract and segment the tumor, we used different techniques such as SOM clustering, k-mean clustering, Fuzzy C-mean technique, curvelet transformation. Enhancement and filtering are important because edge sharpening, enhancement, noise removal, and unwanted background removal improve image quality and detection. Among the various filtering methods: reduces noise; improve image quality and improve computational efficiency compared to other filtering methods. Following the improved image quality and noise reduction discussed here, brain tumor segmentation methodology based on brain MRI images was employed.

In the future, optimization techniques may be applied to decide how many layers and filters can be used in a model. This model takes the input as MRI images of the brain with tumor and without tumor and produces the output in terms of Yes or No when detected with the brain tumor. The website which is designed is cost-effective and it is helpful for self-diagnosis. Quick medical support is also being provided which makes the website more effective for the users.

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