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Nine-layer CNN for detection of the cancerous growth of abnormal cells in the brain

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ABSTRACT

A brain tumor is a group of development of abnormalities brain cells. There are numerous forms of brain tumors. Some brain tumors are cancerous, whereas others are noncancerous. Brain tumour identification involves several phases, including the capture of an input MRI image, the conversion of the input image to a grayscale image, the applying of filters, segmentation, feature extraction, and classification. The detection of a tumor is a difficult process. The position, size,and shape of the tumor differ greatly from patient to patient, making segmentation a difficult process.The detection of a tumour is a difficult process. The position, shape, and structure of the tumour vary greatly from patient to patient, making segmentation a difficult process. A Nine Layer CNN architecture including input layer, zero padding, Conv2D, Batch Normalization, Re-Lu, Max pooling, Max pooling, Flatten, and Dense layer is designed in this study. TCIA Brain tumour dataset is used to train the Nine Layer CNN. TCIA dataset is augmented to overcome overfitting circumstances. In order to overcome overfitting conditions TCIA dataset is augmented . CNN nine layer produced a decent outcome, with a training accuracy of 98.93%. If the classifier determines that the pictureis a tumour present image, it will also provide the proportion oftumor.

Keywords*—Cancerous, Noncancerous, Nine Layer, ReLu, TCIA, Augmented etc.,*

1. INTRODUCTION

A brain tumor is characterized by abnormal cell growth inside the brain or central spinal canal. Because some tumors are malignant, they must be recognized and treated as soon as possible. Because the actual source of brain tumors is unknown, as is the precise set of symptoms, people may be suffering from it without recognizing it. Primary brain tumorscan be malignant or benign.

There are several approaches for detecting and segmenting brain tumors. MRI, CT (Computed Tomography), digital mammography, and other imaging techniques are helpful in detecting many types of illnesses. MRI is a non-ionizing radiation imaging method that produces efficient therapeutic pictures. Magnetic resonance imaging devices produce very detailed pictures of biological tissue. Image segmentation is critical in the processes preceding the implementation of object recognition in medical imaging.

Accurate measures in brain diagnosis are challenging due to the variety of tumour forms, sizes, and appearances. Tumors can develop rapidly, producing abnormalities in nearby tissues and resulting in an overall aberrant structure for healthy tissues.
A standard approach for detecting and segmenting tumours with high accuracy is required, one that can function despite vast changes in tumur location, development, and shape inside the brain. However, applying image image processing methods significantly increases computing time. The studiesare shifting to computer vision approaches such as machine learning and deep learning. The results of machine learning were good, however feature engineering and classification are two separate approaches. Deep learning methods are used to address these drawbacks. Deep learning allows users to create neural networks that automatically identify labels by creating them. In this paper a Nine layer CNN architecture isdesigned to classify the tumor with tumor percentage.

2. RELATED WORKS

Numerous researchers have suggested numerous techniques for segmenting brain tumors from MRI data. The Fuzzy C approach grouping algorithm and histogram equalization[4] were used to provide an efficient and creative finding of the brain tumour location from a picture in [1].

Wavelet transforms[3] were proposed in [2] because of their temporal resolution, that indicates that can collect both regularity and position information in pictures, and SVM[3] has the distinct virtue of minimizing the real classification error and increasing the architectural border concurrently.

[2] suggested a novel approach for colorful MRI images thatuses the watershed[5] technique in conjunction with the edge detection procedure. It is a hue brain tumour identification method that uses colored MRI Brain data in Color space to detect tumors. The RGB picture is transformed to an HSV color image, which is then divided into three regions: saturation, intensity, and Hue. Following Watershed method, contrast enhancement method is used to each section of the picture. The resulting picture is subjected to the Canny edge detector[13]. The final brain tumor segmented picture is created by merging the three images. [6] presented a method for determining the precise size and position of a cancer. This work proposes the K- means clustering[14] technique for tumour diagnosis based on morphological and segmentation algorithms. First, the MRI picture is Pre- processed. After that morphological operator is employed to remove the noise in MRI scanned image, the picture is submitted to K-means clustering. Finally, the excised tumor part's area is determined.

In [7] they conducted research on Automatic Brain Tumor Detection utilizing a multiple technique that included the k-means clustering method, the Hierarchical Centroid Shape Descriptor (HCSD), extraction of features, and classification techniques. [8] Sobel thresholding is a frequently used edge detection approach that considers just information along with axes. [9] presented a thresholding strategy for detecting brain tumors. The suggested approach can detect and identify brain tumors from MRI images in effective manner.

[10] proposed a fresh holistic model for brain tumour classification based on the fuzzy c-means and support vector machine (SVM). The intended approach is a hybrid techniquefor brain tumour prediction that combines with fuzzy c-means. with support vector machine (SVM) . [11] suggesteda new technology known as computer-aided detection (CAD) devices to assist medical specialists in experimental verification utilizing image processing techniques. The goal of this research is to implement a bulk detection algorithm onbrain MRI (Magnetic Resonance Imaging) pictures. The CAD system described in this paper is based on morphological and histogram equalization image processingmethods. [12] suggested a technique CNN pictures were utilized to identify a tumour using MRI. Images were initiallyused with CNN. The accuracy of the SoftMax Fully Connected layer used to classify pictures was 98.67%.

3. MODEL PROPOSED

The major goal is to classify the input MRI image as tumor present image and tumor absent image. To train the network TCIA dataset is considered and software used to solve computer vision is Jupyter note book.

A. Block Diagram

Below figure shows the block diagram of experiment.

Contouring

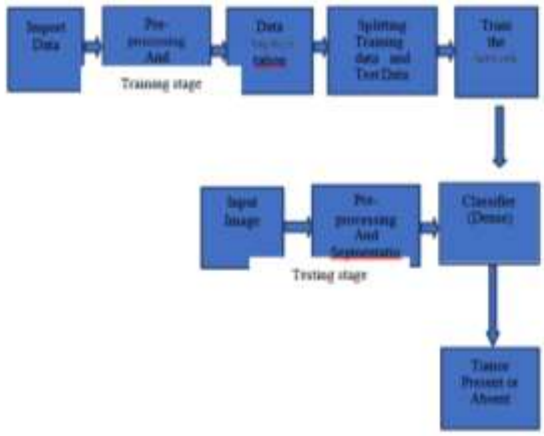

Fig 3.1(a) Block diagram of proposed model

B. Dataset

TCIA dataset is accessible for experimental purposes. The TCIA dataset comprises 253 photos of tumour and non-tumor patients. In that there are 155 tumour photos, i.e., 155 people, which are labelled as "Yes," and 98 non-tumor images, which are labelled as "No."

The tumour photographs have sizes such as 180 X 218, 209 X 212, 456 X 519, whereas the non-tumor images have dimensions such as 630 X 630, 225 X 225, and 201 X 250.

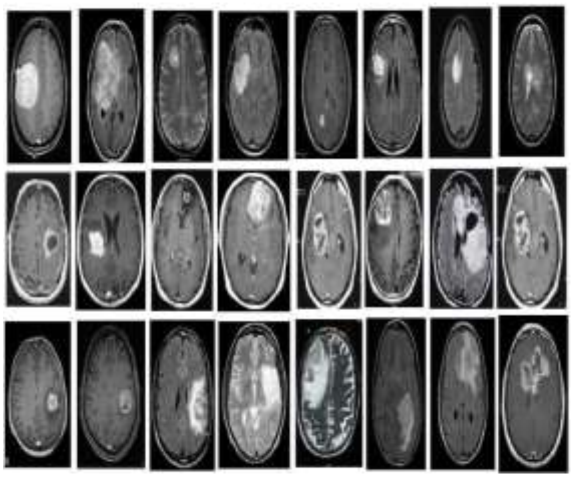

Fig 3.2.1(a) sample images having brain tumor

The above figure shows some sample images which arehaving brain tumor.

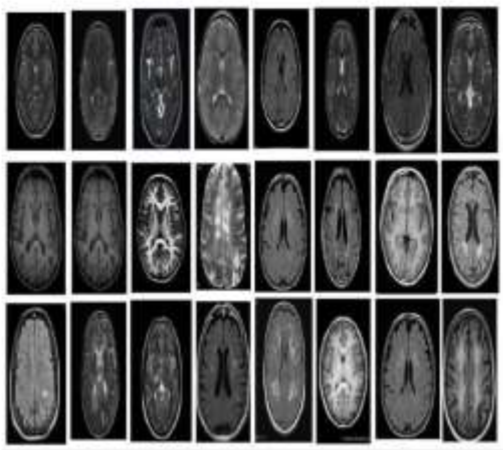

Fig 3.2.1(b) sample images without brain tumor

C. Preprocessing

Preprocessing algorithms include cvtcolor, guassianblur, threshold, erode, and dilate. To convert an image from one

colour space to another, use the cvtcolor () function. The guassianblur() function blurs a picture by smothering it, that is, by deleting outlier pixels that may constitute noise in the image. The threshold () function modifies the picture so that each pixel with an intensity value larger than the threshold isassigned the minimum intensity . The erode () technique is used to erode the picture. The Dilate () technique takes two inputs, one of which is our input picture, and the other isknown as the structuring element or kernel, which determinesthe nature of the operation.
The contour approach is used to eliminate the other regions, i.e. the undesirable information in the provided image.

D. Data Augmentation

Data augmentation is done by setting parameters like width_shift_range to 0.1, height_shift_range to 0.1, shear_range to 0.1, brightness_range as (0.3, 1.0), horizontal_flip, vertical_flip, fill_mode to 'nearest' a single image is augmented to 21 images. From figure 3.3(a) and Figure 3.3(b) it is clearly shows before augmentation and after augmentation.

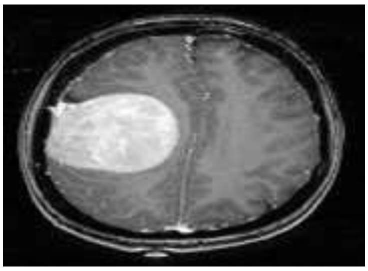

Fig 3.3(a) Before Augmentation

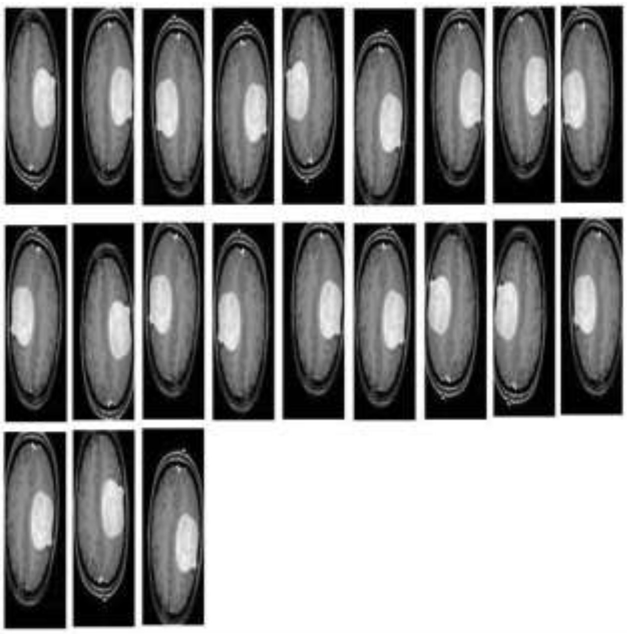

Fig 3.3(b) After Augmentation

E. Training The Network

The figure 3.4 shows the flow of the process, after importingthe data it will be Pre-processed and countered with mentioned algorithms and than augmented by setting above parameters. After the data augmentation the next step istraining the network. Before go for training there will be training parameters. From the entire dataset 70% of the data is splitted for training and 30% of data for validation. That 70% data is trained by setting parameters like batch size to 32, no of epochs to 24 and trained in sgdm environment. Theentire training is done in normal CPU computers. The training curves are shown in figure 4.2(a) and 4.2(b).

4. RESULTS

a) Pre-processed and Contoured Output

Figure 4.1(a) hows pre-processing and contouring the input dataset.

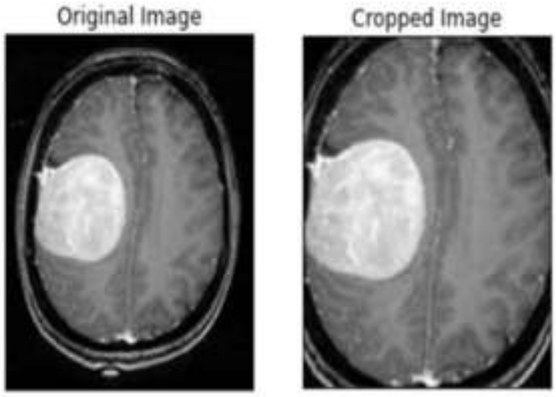

Fig 4.1 Pre-processed and Contoured Image

B. Training Curves

Below figure 4.2(a) , 4.2(b) shows the training accuracy and loss curves respectively of CNN Nine layer network.

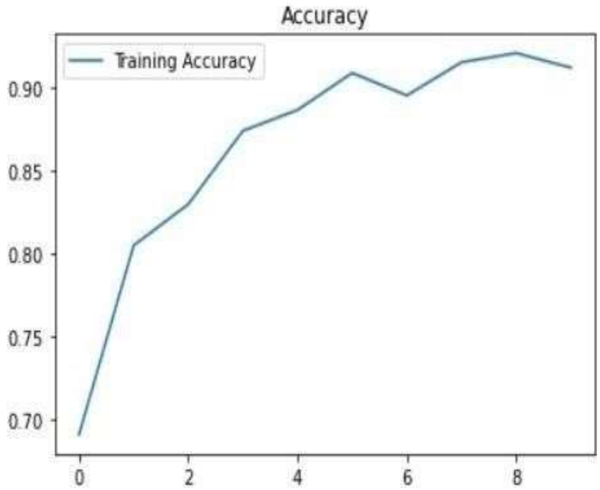

Fig 4.2(a) Training Accuracy Curve

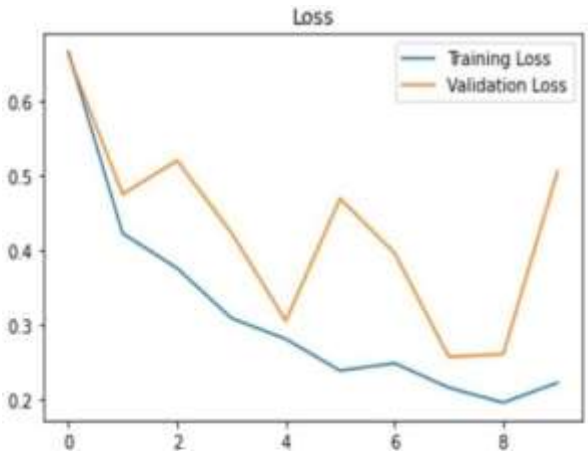

Fig 4.2(b) Training Loss Curve

C. Testing Results

After the training the network it is tested with some random images, the below Fig 4.3(a) is a tumored image and it is given as input to the classifier it is cropped and classified as Brain Tumor detected with the tumor percentage present in brain. And also Fig 4.3(b) is a tumor absent image and it is given as input to the classifier it is cropped and classified as No Brain Tumor.

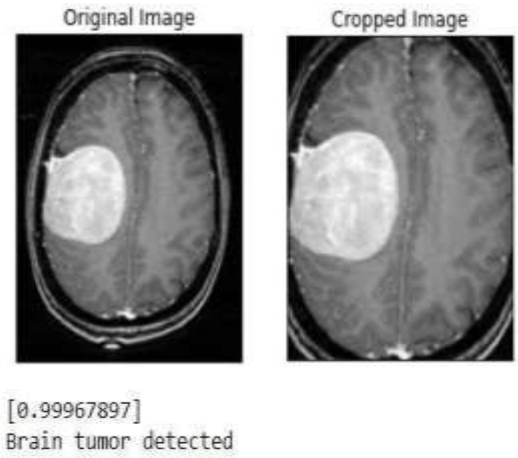

Fig 4.3(a): Testing output when tumor is present

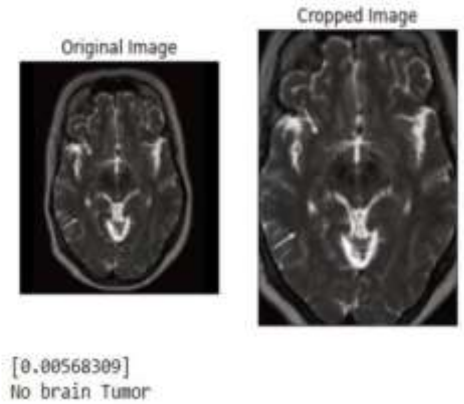

Fig 4.3(b): Testing output when there is no tumor

5. CONCLUSION

In this proposed method a 9-layer CNN architecture is designed for brain tumor detection. All the dataset images arepreprocessed with algorithms like cvtcolor guassianblur, thershold, erode, dilate and later cropped by using counter algorithm. The network is trained with TCIA brain tumor dataset by splitting 70% of data for training and 30% of datafor validate the trained network. In this proposed model no ofepochs used is 24 and trained in CPU processor. And finally the network was trained with accuracy of 98.93%. With somerandom images other than dataset the network is tested. In thegiven input image if the brain tumor than the output shows asBrain Tumor detected with including percentage of tumor present in the brain and if there is no tumor present in the input image it displays as No Brain tumor. The small limitations in these approach is because of using image pre-processing and contouring algorithms computation increases. And in future by extending the proposed method there may be a chance to find what type of tumor it is.

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