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COMPARISON OF BRAIN TUMOR DETECTION AND CLASSIFICATION USING CT AND MRI IMAGE

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***Abstract*—Brain Tumor is one of the severe diseases among many other tumors. They can be diagnosed by many imaging modalities commonly used are CT and MRI scans. In this paper, a comparison between both modalities is performed. The first part was Brain Tumor detection using Morphological Segmentation and Area was determined. The second part was the classification of tumor. The performance efficiency is determined and compared for the two modalities.**

***Index Terms*—CT image, MRI, convolution, confusion matrix, tumor.**

I. INTRODUCTION

Brain tumor is an uncontrollable growth of an infectious cell in the brain region. The incidence of central nervous system (CNS) tumors in India ranges from 5 to 10 per 100,000 population with an increasing trend and accounts for 2% of malignancies. [7]

According to the International Association of Cancer Registries (IARC), over 28,000 instances of brain tumors are recorded each year in India, with over 24,000 individuals dying from them each year.

According to AANS (American Association of Neurological surgeons), more than 150 tumors are documented, but two main groups are primary (originate from brain tissue itself) and metastatic (originate from other parts like lungs and then migrate to the brain). Accordingly, to WHO there are four grades, Grade I and Grade II are low grade and Grade IV and Grade III are high grades.[1]

To diagnose brain tumors, many medical imaging techniques are available. Some of these are CT (Computed Tomography), MRI(Magnetic Resonance Imaging), PET(Positron emission tomography), MRS(Magnetic Resonance spectroscopy), etc.Other diagnostic methods like biopsy and neurological exams are also being used.

Different brain tumor detection algorithms have been developed in recent years. Water based Segmentation Techniques used to detect and calculate area [1], threshold based, region based and morphological based Techniques have been proposed for Detecting tumors and some of its features.

For the classification of tumors, many neural networks, fuzzy mean, k-mean, SVM(support vector machine[5], CNN, and deep learning algorithms have been developed and implemented.

The first part of this paper, tumor detection and calculating the area occupied by the tumor in the brain. The second part is the classification of.Later the performance evaluation is made for both the parts using a confusion matrix. Finally the comparison between CT and MRI is concluded.

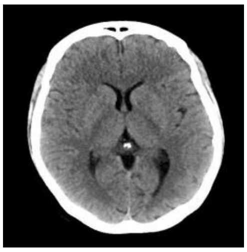

Fig 1. Normal brain CT image

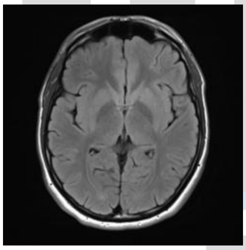

Fig 2. Normal brain MRI image

II. METHODOLOGY

A. *Tumor Detection:*

The brain tumor area detection is the major part of this paper. As mentioned there are different techniques applied for the detection of tumorous region detection. Here morphological segmentation technique is used for detection. Through the help of erosion and dilation followed by Segmentation, the region of interest is determined. The dataset containing CT images and MRI Images of brain tumor patients were obtained from Kaggle.

The methodology for this process is as follows. The first step is preprocessing which is performed for the removal of noise and image enhancement. The RGB image is converted to grayscale image. The second step is morphological operations to find the region of interest. In this step erosion followed by dilation is performed to achieve image opening and closing morphological operations. The difference between erosion and dilation gives the morphological gradient through which the tumor boundary is determined. The contrast-limited adaptive histogram equalization is performed for enhancing the tumor-related region and image quality. The tumor area is selected and displayed using the region of interest. Thresholding followed by opening is performed to determine the area. The opening operation is performing dilation followed by erosion. The bandwidth of the region of interest gives the tumor area.

The scatter plot of the area determined for 30 image samples is shown in Fig.3. From the plot it is analyzed that the most of pixels are occupying in the smaller range thus occupying a less region with benign level of tumor. Comparison between CT and MRI images shows that MRI are more particular for determining the size of the masks obtained from the tumor images.

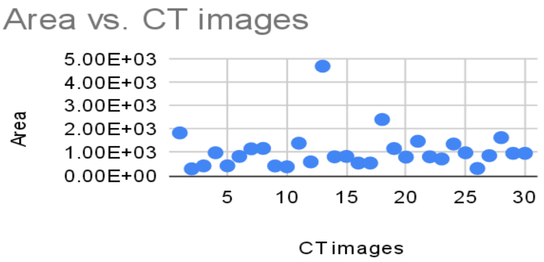

Fig 4. Scatter plot of Area versus corresponding CT Images

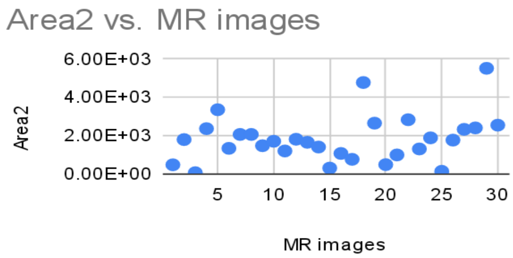

Fig 5. Scatter plot of Area versus corresponding MR Images

B. Tumor Classification:

Define the training and testing of images with tumor or without tumor was performed for the classification of tumor. The dataset for presence and absence of brain tumors were collected from Kaggle. This dataset of MRI images were classified using keras. Convolutional Neural Networks (CNN) are deep neural networks having the ability to segment and classify images. In this paper, the CT and MRI images were classified using CNN model to predict the presence of tumor. Images with tumors were fed to the training set.

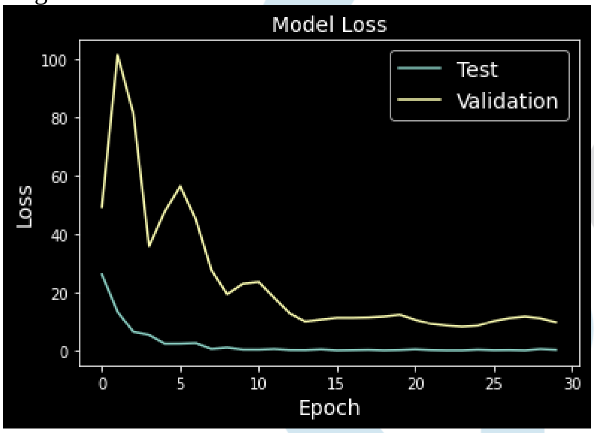

Fig 6. Validation for classification model

The model building was performed using the batch normalization technique where the dataset was divided into small group of batches and performs training for very deep learning. The batched images were convoluted, max pooling was performed and thresholding was done as the next step. The model then identified any dissimilarity and plotted the model loss. The validation for training and testing was performed and model loss was plotted as shown in Fig 4.

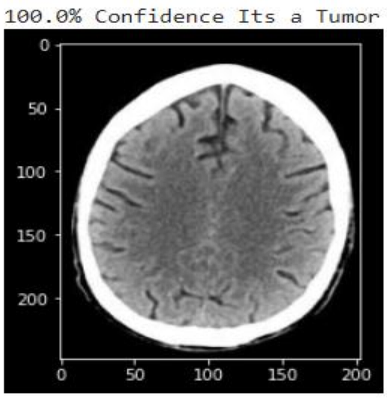

Fig 7. CT with tumor

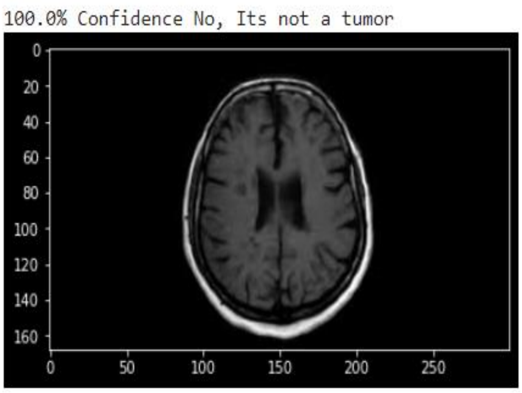

Fig 8. MRI without tumor

III. PERFORMANCE EVALUATION

Classification of tumor and non-tumor images was performed. The confusion matrix evaluating the result into true or false and positive or negative was identified to validate the CNN model. Table 1 displays the confusion matrix for CT and MR images. True positive stands for tumor image with positive prediction. True negative stands for tumor image with negative prediction. False positive stands for non-tumorous with positive. False negative for non-tumorous and negative prediction.

The confusion matrix provided in table 2 provides sensitivity, accuracy, and specificity. To calculate we use the following formula:

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN}$$

$$Sensitivity = \frac{TP}{TP + FN}$$

$$Specificity = \frac{TN}{TN + FP}$$

From table 1. Confusion matrix, it shows the number of images predicted for that set of parameters. The accuracy was 93.33 % for MR images based on true events in the matrix. For sensitivity comparison it showed excellent sensitivity in MR image than CT image. The specificity was more particular with MR images. The efficiency calculated is shown in Fig. The MRI shows greater efficiency than CT images, as the images obtained are trained most for the MRI images. But it still works for CT images as they have most of the similar features.

Table 1. Confusion matrix for CT and MR image

	True Positive	True Negative	False Positive	False Negative
CT images	14	1	12	3
MRI images	15	0	13	2

Table 2. Performance Evaluation of CT and MR Images

	CT Images	MR Images
Accuracy	86.67%	93.33%
Sensitivity	93.33%	100%
Specificity	80%	86.67%

IV. CONCLUSION

In tumor detection morphological processing is used and the area is calculated. In comparison with CT and MRI Images, it was found that MRI shows better accuracy with respect to the area determined. In classification, accuracy, specificity, and sensitivity were evaluated for the CNN model. The results show that MRI is computed more efficiently and tumor detection levels are identified and validated. For future scope, a much more efficient method can be identified and used for the separation of different types of tumors. The benign and malignant can also be differentiated.

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