Multi Classification of Brain Tumor MRI Images Using Deep Learning Technique

Nandhinidevi.S[1], Harish.S[2], Narresh.M[3], Yokeshwaran. D[4]
[1]*Assistant Professor, Kongu Engineering college*
[2,3,4] *Student, Kongu Engineering college*

Abstract **- Brain tumor is one of the most dangerous cancers in the world. Adults and children are affected by this cancer. The identification of the correct type at early stage gives a life to the patient by giving precise treatment. The misclassification of the tumor brain leads to dreadful consequences. By investigating the magnetic resonance imaging (MRI) images of the patient's brain, physician distinguish the type of brain tumors. The manual examination sometimes leads to misclassification due to various type of tumor and human error. To assist radiologists, we proposed a CNN model for multi class classification to identify the type of tumor such as Glioma tumor, Meninglimoa tumor, Pituitary tumor and No tumor. The proposed model achieved 93.72 % testing accuracy and 96.51 validation accuracy.**

I.INTRODUCTION

The brain tumor is observed as one of the most dreadful brain diseases. It is an unusual growth of cells in the brain or close to the brain. Between the various available techniques (CT scan, EEG, MRI), MRI is most preferred for brain tumors. MRI gives in-depth information on the internal organs. The radiologist identifies the brain tumors manually. The classification process takes more time, and the accuracy is based on the ability and expertise of the radiologist. And also, the classification of tumor into a variety of tumor is more challenging one compared to the binary classification. Some images give same appearance even they come under different tumor. The incorrect diagnosis of a brain tumor leads to a severe problem and reduce the chance of survival for the patient. hence, an automated predicting systems are required to replace the conventional manual prediction of tumor. A lot of techniques have been projected for the classification of brain tumor which are labeled into machine learning (ML) and deep learning (DL) based on feature selection and learning mechanism. In current research developments, CNN architectural is used to defects the computational problems such as time consumption and accuracy. In this study, we proposed a CNN model classify the MRI Image as no tumor, Glioma tumor, Meninglimoa tumor, Pituitary tumor.

The rest of this paper is ordered as follows: Section II illustrate the related work on deep learning in medical image processing with MRI. Section III tell about the data set used in this proposed work. Section IV express the data preprocessing for the betterment of our accuracy. section V demonstrate the proposed CNN models in detail. Experimental results are reported in Sect.VI. Section VII is the last section and concludes the paper.

II. RELATED WORK

Many researchers have applied Machine Learning and Deep Learning techniques for image processing such as segmentation, classification and detection of tumor using MRI images. So many works have been done on Binary and Multiclass classification done on brain tumor. We reviewed on the classification on brain tumor. S.Deepak and P.M Ameer[1] applied deep transfer learning for multiclass classification using GoogLeNet for feature extraction and achieved 98% accuracy. Hassan Ali Khan et al[2] proposed a CNN model for binary classification and compared with VGcG, ResNet and Inception-V3 with same data and achieved 100% accuracy. Muhammad Attique Khan et al[3], have applied VGG16 and VGG19 CNN model for feature selection on three dataset and found the best features using ELM and achieved better accuracy. HH. Sultan et al[4] proposed a CNN model without segmentation approach to classify the MRI image into

3 types and classify the gliomas into different grades with the help of deep neural network structure. In this model, data augmentation is applied to achieve high accuracy. H. N. T. K. Kaldera [5] performed classification using CNN and Faster R-CNN was used for segmentation and localization. Sunanda Das et al [6] applied image preprocessing techniques and perform the classification on MRI T1-weighted contrast-enhanced images and achieved 94.39% accuracy. Mzoughi et al.[7] (2020) proposed a deep multi-scale 3D CNN model for grading brain tumor using 3D MRI images and achieved 96.49% accuracy in classifying the brain tumor images .

Abiwinanda et al.[8] implemented the simplest CNN architecture to identify three most common types of brain tumors, i.e., the glioma, meningioma and pituitary and got the validation accuracy of 84.19%t. In 2019, Hossam et al.[9] modeled a CNN architecture to classify brain tumors into meningioma, glioma and pituitary and make a distinction between the three glioma grades (Grade II, Grade III and Grade IV). Mohsen et al. (2018) applied deep neural network (DNN) classifier with the combination of discrete wavelet transform (DWT) and principal component analysis (PCA) to classify brain MRI images into four classes as normal brain, glioblastoma, sarcoma and metastatic bronchogenic carcinoma tumors.

III. DATASET

MRI image data set is adopted for doing this proposed work which is taken from public source. This dataset contains 3950 images with four different types of class: Glioma tumor, Meninglimoa tumor, Pituitary tumor and No tumor. The entire data set is randomly grouped into three categories for training, testing, and validating with 60:20:20 ratio. The existing systems have applied their models in the brain tumor dataset. We also applied our proposed model in the same data set. Sample images of different tumor and normal brain is given in the Fig.1

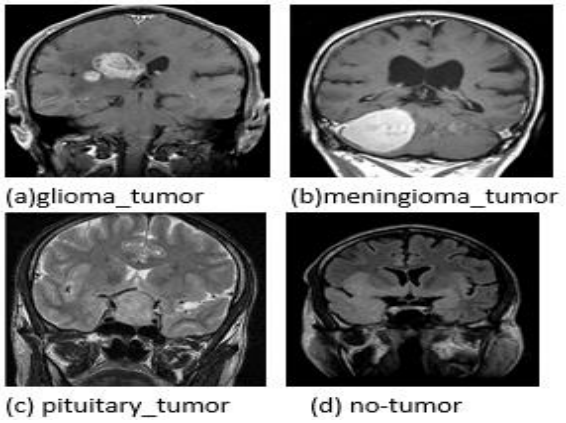

Fig 1 Data set

IV. DATA AUGMENTATION

It is a technique to increase the size of data by applying different operation on data. In this image data set, we performed scaling and rotation operation on the image. Hence, the original data set size is enlarged to 3 times of the original data set.When we are having the large data set,it avoid the overfitting.

V. METHODOLOGY

There are many approaches in the classification of images, and the distinctive method is Convolutional Neural Networks (CNN) which is a well-accepted supervised deep learning method. Generally, CNN is applied for classification of images and also for object detection in the field of Computer Vision.

The classification model contains many layers such as convolutional, MaxPool, and fully connected. This model contains several layers, each layer is having its own functionality. The input for the model is an image with the size of 256 X 256.In every layer, we applied conv operation to extract the features and used pooling function such as max pooling and avg pooling to find maximum and average values.In all convolution layers, commonly we used 3X3 filter and 2X2 size is applied in pooling operation. Relu is used as activation function in all layers. The output of these layers is feature vector which is flattened and given to Fully connected layer. Finally, we have the utput layer with 4 neurons with softmax activation function. the proposed CNN model is compiled with optimizer as RMSprop and the loss function as binary cross entropy.

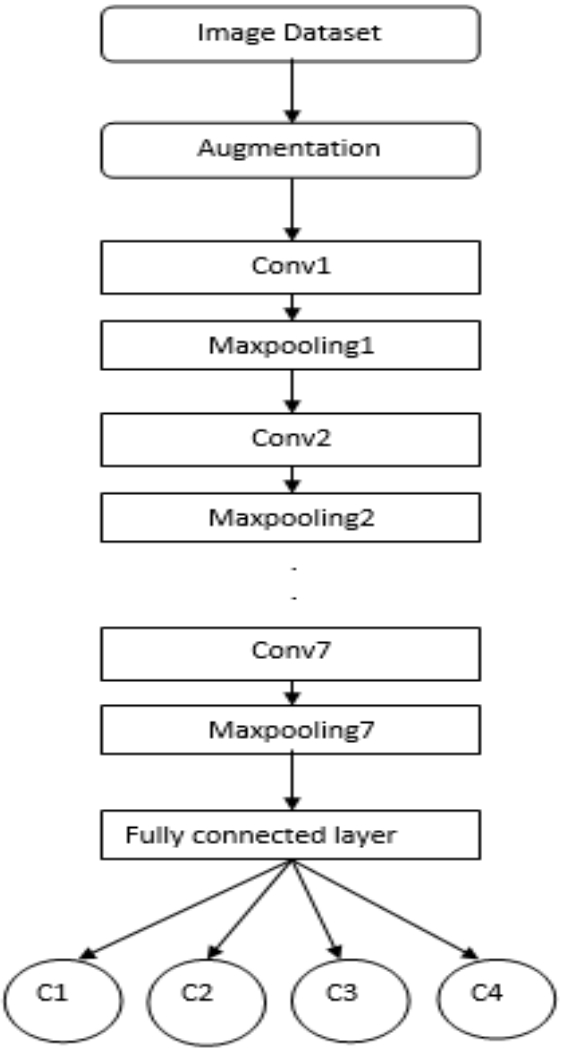

Fig 2.CNN Model

The model has been run for 100 epochs on training and validation data set and obtained 97.43% accuracy. The Fig.2 depicts the proposed CNN Model where C1, C2, C3 and C4 refers the classes of Glioma tumor, Meninglimoa tumor, Pituitary tumor and no_tumor.

VI. RESULT ANALYSIS

The sequence of steps carried in CNN is reading the images, augmenting the images to increase the size of data set, applying the corresponding models and interpreting the results. The Fig.3 depicts the training and validation accuracy of our model. The Fig.4 depicts the training and validation loss of the proposed CNN model.

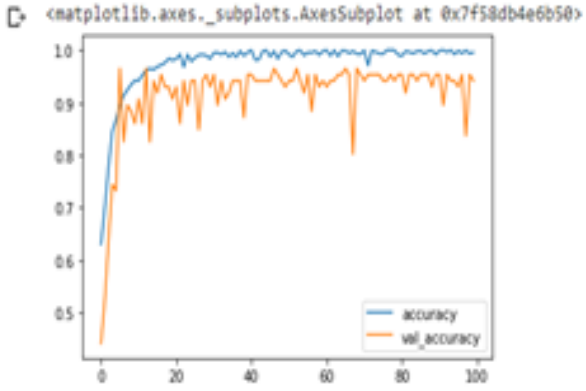

Fig.3 Training and validation accuracy

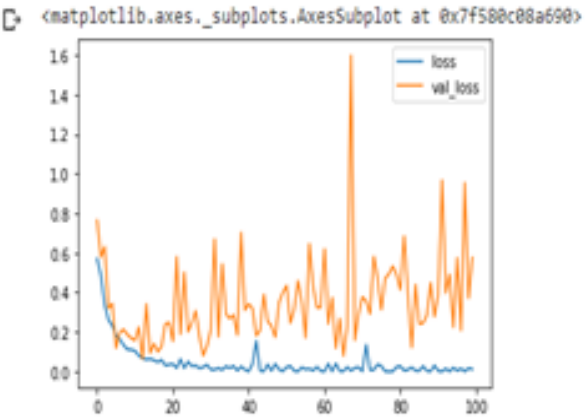

Fig.4 Training and validation Loss

VII. CONCLUSION

This paper provides the multi-class classification model to classify the brain tumors for the early diagnosis process. This model is trained and tested with adequate number of images. This model will assist radiologists and physicians in the validation of the initial screen.

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