Various Class Categorization Scheme using a Machine Learning Technique to Identify a Lesion in Brain Image

Madhuri S. Gawai[1], Prof. Vijayashri A. Injamuri[2]

[1]M.Tech Final Year Student, Department of Computer Science and Engineering, Government College of Engineering, Aurangabad, Maharashtra, India.
[2]Associate Professor, Department of Computer Science and Engineering, Government College of Engineering, Aurangabad, Maharashtra, India.

---***---

Abstract - — *Brain tumors can start within the brain by growing cancerous or non-cancerous abnormal cells. It is treatable by medical professionals with the assistance of diagnosis. However, it's challenging chore because of the irregular form and mystify boundaries of tumors. During this paper, a regular dataset of MRI is employed to propose a computerised U-Net framework to spot lesions in brain images by applying advanced machine learning techniques like deep convolutional neural network (deep ConvNet) and vector geometry group (VGG16) and the image processing with the employment of soft max technique on multi classes of neoplasm. The proposed work segments the tumor mainly into four classes such as edema, necrosis, enhanced tumor and healthy tumor with high accuracy this is an important step for prediction and treatment planning.*

Key Words— Brain tumor, Magnetic resonance imaging (MRI), Deep convolution neural network (deep ConvNet), Visual geometry group(VGG16), Image processing, Segmentation.

1. INTRODUCTION

The growth of the abnormal cells within the human brain indicates the brain tumor, Human brain is stiff so any cell growth therein restricted area causes serious problems, which aren't any control over the expansion of the cells because in such situation the abnormal cells start developing irregularly and end with confusing boundaries of the brain. There are mostly two varieties of brain tumor one is the primary tumor, originates within the brain next one is secondary tumor and it originates in the other organ by spreading the cells from the brain. This are often cancerous that's malignant or non-cancerous that's benign. There are several classes of tumor first is edema is that the spill of plasma it causes trauma, stroke, second is necrosis it occurs after subjection to fractionated radiation it causes death in small number and a 3rd is that the enhanced tumor this are the three main classes those are tricky to search out by manually and by medical operators this are fully dependent hence becomes time-consuming. That's why digitization within the tumor prediction could be a necessary step to handle death ratio by decreasing in error rate, having more accuracy with less time consumption likewise because it solves life-threatening problem by having a patient's history to deal with risk factors. The research focuses on constructing a multiclass system to spot lesions in brain images with the assistance of giant dataset and machine learning techniques. The dataset is of MRI is a medical imaging technique to create an image it uses strong magnetic field and radio frequencies to get a close picture of organ, whereas the machine learning is that the study of computer algorithm it's the power to be told and improve the experience and therefore the main machine learning techniques focus here are: the deep convolutional network it could be a deep learning algorithm which may take input images and assign importance to them with various objects which ends to differentiate image one from another. Visual geometry group sixteen (VGG16) it consists a deep learning excellent vision architecture having sixteen convolutional layers which are most beneficial for classification and detection with high accuracy, image processing is that the digital method which allows performing some operation on a picture to extracts the useful information, soft max technique uses weight cross-entropy and generalized dice loss function to turn the mathematical output of last layer of neural network into logistic output. Machine learning (ML) techniques used in the proposed architecture are helps to detect tumor in early stages hence eventually increases survival ratio and this are highly efficient techniques. Involvement of machine learning techniques in digitization eventually contributes in the life science. Keras plus tensor-flow is the python open source platform and it has high-level application programming interface as well as artificial intelligence library which are used to build modules of the proposed system.

2. EXISTING METHOD

The existing method uses deep learning model supported a convolutional neural network to detect brain tumor and classifies the tumor into three different classes with glioma grades. But the proposed work failed to use the newest technologies like tensor flow to innovate within the healthcare industries. The work is proposed by three authors named as Hossam, Nancy and Walid [1]. The related work of tumor segmentation by author M Malathi* and P Sinthia [2] uses BRATS2015 dataset of MR brain images. The article reviewed the segmentation using tensor flow and anaconda framework to get high accuracy. But during this work, the entire architecture relies only on the convolutional neural network technique. The prevailing method of author

G. Hemanth, M. Janardhan, L. Sujihelen [3] focuses on separating distinct tumor cells from the traditional brain cells by using ConvNet and applied feature extraction. The proposed work uses MATLAB environment for architecture development.

3. PROPOSED METHOD

During this section of the paper, the proposed architecture discussed in detailed starting with the dataset utilized in it and therefore the way the dataset is used for further experimentation to adapt new machine learning techniques is illustrated. Further, the flow of complete architecture is mentioned. There are four stages of this application using that effect will obtain. During this proposed system BRATS2017 dataset is employed as an input which contains high-grade glioma and low-grade glioma MR images. The proposed system uses machine learning techniques vector geometry group sixteen (VGG16) and deep convolutional neural network (deep ConvNet).

4. WORKING

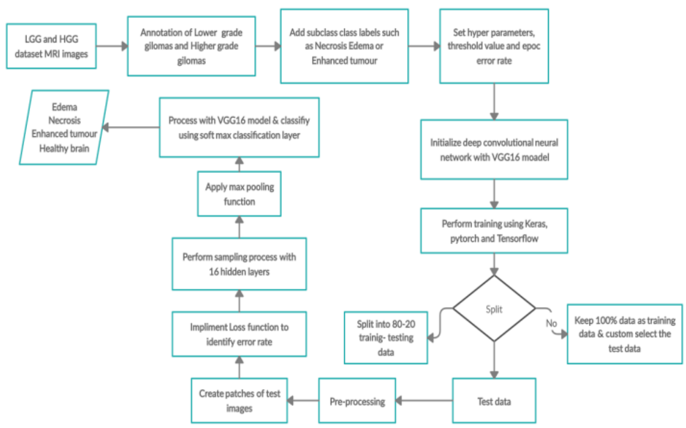

Figure 1: Overall architecture

4.1 Pre-processing:

Pre-processing plays a very important role during this system. Pre-processing could be a picture processing method performed on test data for training. It uses resonance images as input then annotation part on images is completed as per the differentiation of tumor classes and sets the hyper-parameters. The proposed system mainly focuses on four classes of tumor edema, necrosis, enhanced tumor and healthy brain. While pre-processing as per each input image scan there are 155 slices of the image produced. During this part generates the image patches and extracted them specifically so should get tumor region and brain boundaries obtained using the watershed image detection technique. Here data of images are collected and distributed them to make weighted models for training.

4.2 Proposed architecture:

During this phase of the system data augmentation obtain. Deep ConvNet includes deep learning (DL) and artificial neural network (ANN) is applies to deal with huge pixel data. VGG16 applies to relinquish large scale image recognition and better visualization over huge data. Now the information is split into the training sets and followed by their individual target label. The proposed system training model follows the supervised learning. The proposed deep ConvNet and VGG16 all at once form a U-Net framework and offer the cross-entropy model. First layer which holds an augmented image is the start of the pre-processing stage. Input layer is employed to substantiate the pixel size and color of the image. The image is felt a stack of the convolutional layer where the filters used to fix each pixel. Rectified linear measure (ReLU) activation function is applied on a picture to convey max-pooling of the input and also the final layer is that the softmax layer all of those layers results to stop over fitting. ReLU activation function graphically represented as:

$$F(x) = \max(0, x)$$

After performing the training by using 16 hidden layers, segmentation is performed to get model files to use under the testing phase. Watershed image segmentation is used in the image processing for color based segmentation and to highlight the tumor region. The threshold value and watershed parameter breaks down the image into patches to perform segmentation.

4.3 Evaluation metrics:

Evaluation metrics are a part of the experimental setup to attain the effectiveness of the model. While training a model in iteration there is a certain amount of epoch error generates. ML techniques are applied to fix the relative error rate and give consistent outcome. The performance of the proposed ML techniques accessed with key index parameters like specificity, sensitivity, accuracy and fmeasure of training and testing set. Here, True Positive denotes the prediction for the patients with a brain tumor and were detected with a tumor, False Positive represents the prediction for the patients having neoplasm but were detected with no brain tumor, True Negative denotes prediction for the patients with no brain tumor and were detected with no tumor and, False Negative denotes the prediction for the patients with no tumor but were detected with a tumor [2]. The confusion matrix for the proposed system result obtained as:

$$Precision = TP / (TP+FP) * 100$$

The precision of the proposed framework is only the specificity of the system which is obtained as 97.71%.

$$Recall = TP / (TP+FN) * 100$$

The recall of the proposed framework is only the sensitivity of the system which is obtained as 99.66%.

$$Efficiency = TP+TN / (TP+TN+FP+FN) *100$$

The efficiency of the proposed framework is only the accuracy of the system which is obtained as 98.05%.

$$Fmeasure = 2* Precision * Recall / (Precision + Recall)$$

The fmeasure of the proposed system obtained as 98.68%.

4.4 Experimental results:

The dataset accumulated from online publically available dataset and also the Tensor flow environment used for development process. Input image undergoes for pre-processing stage including the testing process. Thereafter the pre-processing image enhanced and extracted by using deep convolutional neural network framework with VGG16 model. Then the tumor classified image is retrieved.

Figure 4.4.1: Final result of input MRI.

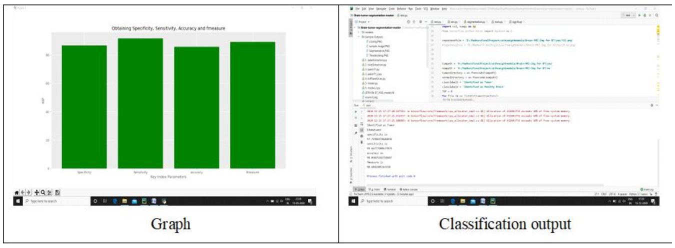

Figure 4.4.2: Graph representation of key index parameters and class categorization.

CONCLUSION

The proposed work utilizes deep ConvNet framework with VGG16 model and Tensor flow environment to develop multi-class classification architecture to classify brain tumor with their class. The aim of the research work is to optimize the reaction time by finishing up the iterations at a faster rate than the present system with enhancing specificity, sensitivity, accuracy and measure of the system.

REFERENCES

[1] M Malathi*, P Sinthia, "Brain Tumour Segmentation Using Convolutional Neural Network with Tensor Flow", Asian Pacific Journal of Cancer Prevention, Vol 20 2095.

[2] G.Hemanth1 , M.Janardhan2 ,L.Sujihelen3 1,2Final Year Student, 3Assistant Professor Department of CSE, Sathyabama Institute of Science & Technology, Chennai,India, "DESIGN AND IMPLEMENTING BRAIN TUMOR DETECTION USING MACHINE LEARNING APPROACH", Proceedings of the Third International Conference on Trends in Electronics and Informatics (ICOEI 2019) IEEE Xplore Part Number: CFP19J32-ART; ISBN: 978-1-5386-9439-8.

[3] HOSSAM H. SULTAN , NANCY M. SALEM , AND WALID AL-ATABANY Department of Biomedical Engineering, Faculty of Engineering, Helwan University, Cairo 11792, Egypt Corresponding author: Hossam H. Sultan (hossam.sultan@h-eng.helwan.edu.eg), "Multi-Classification of Brain Tumor Images Using Deep Neural Network", VOLUME 7, 2019.

[4] Bin Cui1,2, Mingchao Xie1,2, Chunxing Wang1, "A Deep Convolutional Neural Network Learning Transfer to SVM-Based Segmentation Method for Brain Tumor", 2019 IEEE 11th International Conference on Advanced Infocomm Technology.

[5] Mushtaq Mahyoob Salih, "Enhancement of U-Net Performance in MRI Brain Tumour Segmentation using HardELiSH Activation Function", 2019 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE) .

[6] Daisuke Hirahara1, "Preliminary assessment for the development of CADe system for brain tumor in MRI images utilizing transfer learning in Xception model", 2019 IEEE 8th Global Conference on Consumer Electronics (GCCE).

[7] Sinan Alkassar, "Automatic Brain Tumour Segmentation using fully Convolution Network and Transfer Learning", 2nd INTERNATIONAL CONFERENCE ON ELECTRICAL, COMMUNICATION, COMPUTER, POWER AND CONTROL ENGINEERING ICECCPCE19, 13-14 February, 2019 | Mosul, Iraq.

[8] Sakshi Ahuja Electrical Engineering Department IITD New Delhi, India Sakshi.Ahuja@ee.iitd.ac.in, "Transfer Learning Based Brain Tumor Detection and Segmentation using Superpixel Technique", 2020 International Conference on Contemporary Computing and Applications (IC3A) Dr. A.P.J. Abdul Kalam Technical University, Lucknow. Feb 05-07, 2020.

[9] Yakub Bhanothu, Anandhanarayanan Kamalakannan & Govindaraj Rajamanickam, "Detection and Classification of Brain Tumor in MRI Images using Deep Convolutional Network", 2020 6th International Conference on Advanced Computing & Communication Systems (ICACCS).