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Tumor Detection and Classification of MRI Brain Image using Transfer Learning Model

Pawan Kumar[1] and Er. Tarun Dhiman[2]*
[1]*M.Tech, Scholar, Department of Computer Science Engineering, Galaxy Global Group of Institution, Dinarpur, Ambala (Haryana), India.*
[2]*Assistant Professor, HOD, Department of Computer Science Engineering Galaxy Global Group of Institution, Dinarpur (Haryana), India.*

(Corresponding author: Pawan Kumar)*
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ABSTRACT: There are two types of brain tumors: benign and malignant. Brain tumors can be caused by an uncontrollably high proliferation of aberrant cells in brain tissue. While a malignant brain tumor can impact nearby brain tissues and cause a person's death, a benign brain tumor does not affect nearby normal or healthy tissue. It may be necessary to discover brain tumors early to preserve patients' lives. The segmentation, detection, and extraction of an infected tumor region from Magnetic Resonance Images (MRI) is a labor-intensive and essential task performed by medical professionals. The accuracy of this task depends solely on experience, so it is imperative to address it with Computer-Aided Technology (CAD). It uses deep learning techniques such as VGG-19 to classify brain tumors to lessen this issue. The findings indicate that while 356 dense layers perform better with enhanced data, ResNet with 64 dense layers performs better overall in terms of accuracy.

Keywords: Brain Tumor, Deep Learning Models, Image Classification etc.

INTRODUCTION

Brain tumors are atypical cell proliferations within the brain that can substantially affect an individual's physical and cognitive abilities. These tumors may induce symptoms like cephalalgia, convulsions, and alterations in behavior or cognition. In certain cases, untreated brain tumors may pose a life-threatening risk (Chetty *et al.,* 2017; Noreen *et al.,* 2020). Understanding the impact of brain tumors in the body is essential for prompt identification and intervention.

Glioma, a prevalent form of brain tumor, arises from the glial cells that provide support and protection for neurons in the brain. These tumors may differ in size and location, resulting in a variety of symptoms based on their specific site. Glioma in the frontal lobe may result in alterations in personality or decision-making, whereas a glioma in the temporal lobe may induce memory deficits or seizures. A brain tumor can significantly affect the body, influencing physical health as well as cognitive and emotional well-being. Healthcare practitioners and patients must recognize the potential signs and symptoms of brain tumors to enable early intervention and enhanced outcomes. By identifying early warning symptoms, individuals can obtain timely medical intervention and initiate treatment sooner, enhancing their prospects for a full recovery (Lavanyadevi *et al.,* 2017; Anaya-Isaza and Mera-Jiménez 2022). Moreover, comprehending the potential ramifications of a brain tumor can assist patients and their families in effectively managing the obstacles that may emerge during the treatment process. Advancements in medical technology and treatment options provide hope for those diagnosed with a brain tumor to not only survive but also flourish in their healing path. Persistent headaches, alterations in vision, or seizures may serve as preliminary indicators of a brain tumor. Promptly seeking medical assistance can facilitate early diagnosis and intervention, thereby improving the prognosis and quality of life (Khan *et al.,* 2021). Furthermore, acquiring knowledge about the possible side effects and difficulties associated with brain tumor therapy can assist patients and their families in preparing for the journey ahead and managing it more efficiently (Anaya-Isaza and Mera-Jiménez 2022). It is essential to acknowledge that not all brain tumors exhibit conspicuous symptoms. In certain instances, an individual may exhibit no discernible symptoms until the tumor has progressed to a more advanced stage, complicating early detection and intervention (Noreen *et al.,* 2020).

Types of Tumors. Individuals must remain vigilant about changes in their health and seek medical evaluation if they experience recurrent headaches, seizures, visual disturbances, or other alarming symptoms. Timely identification of a brain tumor can markedly enhance prognosis and expand treatment alternatives. This study will include an overview of several brain tumors, their symptoms, treatment modalities, and the significance of early detection and management. By acquiring knowledge and actively overseeing their health, individuals can enhance their likelihood of favorable results when managing a brain tumor diagnosis. Furthermore, folks must sustain

transparent contact with their healthcare providers and adhere to suggested exams and examinations. Routine examinations and imaging assessments can facilitate the early detection of potential problems, enabling timely intervention and treatment. By remaining aware and proactive regarding their health, individuals can assume control of their circumstances and strive for the optimal outcome. Early detection is crucial for the effective care of brain tumors; thus, do not hesitate to consult a medical professional if you have any concerns (Khan *et al.,* 2021).

Implementing proactive measures to prioritize your health and well-being can substantially influence the effectiveness of your treatment. Seeking assistance from loved ones and healthcare experts is crucial for navigating the obstacles associated with a brain tumor diagnosis. Bear in mind that you are not alone in this endeavor, and resources are available to assist you at every stage. By remaining aware, proactive, and connected, you can equip yourself to confront this task with fortitude and tenacity.

Gliomas. Gliomas represent a category of cerebral neoplasms that pose significant treatment difficulties. A complete treatment strategy is necessary, potentially including surgery, radiation, and chemotherapy. Collaboration with your healthcare team is essential to formulate a tailored strategy that addresses your individual requirements. Furthermore, participating in a support group or pursuing counselling can offer emotional assistance and direction as you traverse this challenging path. It is essential to prioritize self-care and seek assistance, when necessary, in managing a glioma diagnosis. Bear in mind that you are not solitary in your struggle, and tools exist to assist you in managing the physical and mental difficulties associated with a glioma diagnosis (Khan *et al.,* 2021). Remain appraised of the most recent research and therapeutic alternatives, and do not hesitate to enquire or pursue second opinions (Amin *et al.,* 2022). By being proactive and cultivating a positive mindset, you can enhance your likelihood of surmounting this challenging illness and leading a rewarding life thereafter. Maintain resilience, cultivate optimism, and persist in self-belief.

MRI SCAN FOR BRAIN TUMOR DETECTION

An MRI scan of the brain provides a safe and non-invasive procedure that use radio waves and a magnetic field to generate detailed images of the brain. An MRI scan differs from a Computed Tomography (CT) scan as it does not employ radiation waves. MRI scans can reveal several brain ailments, including tumors, cysts, edema, hemorrhages, structural abnormalities, inflammatory states, illnesses, and vascular difficulties. A determination is made regarding when a procedure can be performed to identify the affected region of the brain resulting from a stroke or injury (Chetty *et al.,* 2017; Noreen *et al.,* 2020). A brain MRI scan is helpful in evaluating conditions such as persistent weakness, recurrent headaches, blurred vision, dizziness, and this diagnostic procedure aids in identifying certain chronic neurological disorders, including multiple sclerosis. The MRI scan provides distinct images of brain structures that are not as clearly visible in CT scans, X-rays, or ultrasounds, making it particularly valuable for diagnosing issues related to the brain stem and pituitary gland (Chetty *et al.,* 2017).

MRI Image for Brain Tumor Detection. Magnetic fields are employed in MRI scanning to generate comprehensive images of the brain. Magnetic Resonance Imaging (MRI) can be utilized to assess the dimensions of brain tumors. A specific stain is recognized as a contrast standard administered prior to the examination to provide an optimal image. This stain has been administered intravenously to the patient or provided for oral consumption. MRIs produce more detailed images of the brain than standard scans and are often the preferred technique for tumor identification in the brain (Chetty *et al.,* 2017; Noreen *et al.,* 2020). The MRI scan of the brain is conducted based on the suspected tumor type and the likelihood of its progression within the Central Nervous System (CNS). The implications of neurotactin have been determined by the neurologist or internists who assist in selecting the appropriate MRI type. Fig. 1 presents the MRI image utilized for brain tumor detection.

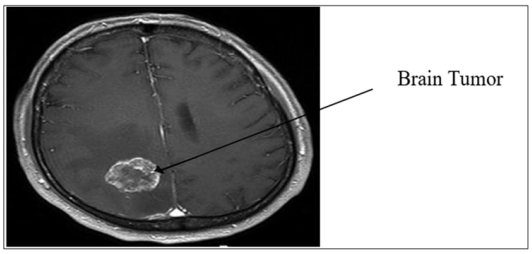

Fig. 1. MRI Image for Brain Tumor Detection.

DEEP LEARNING ALGORITHMSUSED FOR BRAIN TUMOR

VGG-19. Since their creation, the Visual Geometry Group (VGG) models—VGG-16 and VGG-19—have had a substantial impact on the field of computer vision. These models were created by the Visual Geometry Group at the University of Oxford. Their deep convolutional neural networks (CNNs) with a consistent design helped them win the 2014 ImageNet Large Scale Visual Recognition Challenge (ILSVRC). The deeper version of the VGG models, known as VGG-19, has drawn a lot of interest due to its efficiency and ease of use.

2. Inception Model. Inception V1 (also known as GoogLeNet) was the leading architecture at ILSVRC 2014. It has achieved the lowest recorded error on the ImageNet classification dataset; however, there are areas where enhancements can be implemented to increase accuracy and reduce model complexity. Inception V1 occasionally use convolutions, such as 5×5, which significantly reduce the input dimensions. This results in a decline in the accuracy of the neural network. The neural network is prone to information loss if the input dimension is too reduced. Within the Inception V2 framework (Oksuz *et al.,* 2020). The 5×5 convolution is substituted with two 3×3 convolutions. This also reduces computational time and hence

enhances computational performance, as a 5×5 convolution is 2.78 times more resource-intensive than a 3×3 convolution. Utilizing two 3×3 layers instead of a single 5×5 layer enhances the architecture's performance.

3. ResNet. ResNet, introduced in 2015 by experts at Microsoft Research, unveiled an innovative architecture termed Residual Network. This architecture implemented Residual Blocks to mitigate the problem of vanishing or exploding gradients. This network utilizes a technique referred to as skip connections. The skip connection connects the activations of one layer directly to the following layers, circumventing intermediate layers. This represents a residual block. ResNet is constructed by synthesizing these residual blocks.

Why do we need ResNet ? We incorporate more layers in Deep Neural Networks to enhance accuracy and performance, frequently to address complex problems. The concept of layering posits that as more layers are incorporated, they will ultimately acquire more complex features. For example, in the process of image recognition, the initial layer may detect edges, the subsequent layer may identify textures, the third layer may recognize objects, and so forth. It has been determined that the traditional Convolutional Neural Network model possesses a maximum depth limit (Musallam *et al.,* 2022; Majib *et al.,* 2021). This figure illustrates the error percentages for training and test datasets for both a 20-layer network and a 56-layer network.

In both training and testing scenarios, the error rate of a 56-layer network surpasses that of a 20-layer network. This signifies that a network's performance declines with the incorporation of additional layers. This may be ascribed to the network setup, the optimization function, and, most importantly, the vanishing gradient issue. While overfitting may be considered a factor, the 56-layer network exhibits the highest error % on both training and test data, a scenario that does not arise in cases of overfitting.

The ResNet architecture, inspired by VGG-19, incorporates a 34-layer plain network followed by the implementation of shortcut connections. The architecture is eventually converted into the residual network using these shortcut connections, as illustrated in the image below. To execute ResNet version 1 with 50 layers (ResNet 50), we utilize the function provided by Keras (Abdel-Gawad *et al.,* 2020).

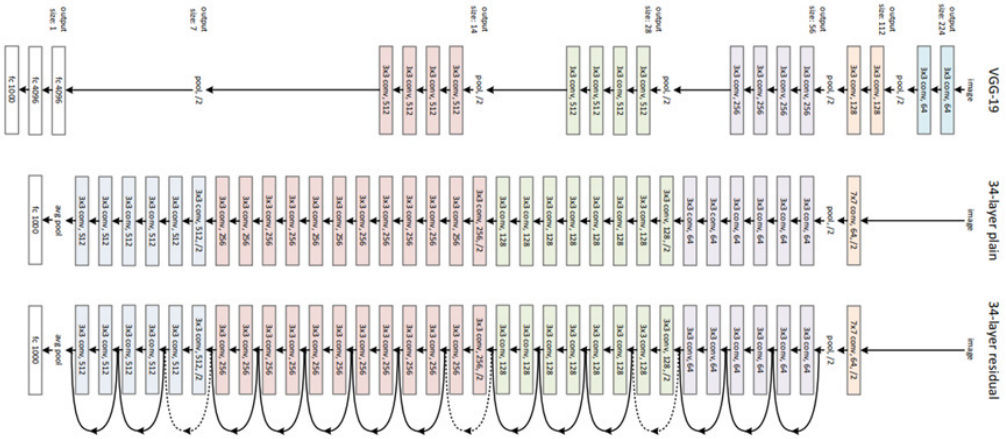

Fig. 2. ResNet Architecture.

RESULTS AND DISCUSSION

The image classification approach can be employed to categorize medical images according to their distinct characteristics. This image classification method has been implemented utilizing spectral bases or spectrally specified attributes, including texture and brain density inside the feature space. In the medical field, picture classification has been performed via a high-speed computer, employing mathematical and efficient classification methods and procedures. The image categorization in MRI encompasses several processes to categorize the image or tumor depicted within.

After examining numerous brain tumor recognition algorithms from the literature (Ejaz *et al.,* 2020; Majib *et al.,* 2021), we determined that Vgg-19, Inception, and ResNet exhibit superior accuracy. We resolved to conduct a more in-depth analysis of these models utilizing a brain tumor dataset comprising 3000 pictures and other parameters. Data augmentation is employed in this context to achieve smooth outcomes.

Table 1: Performance Analysis using Deep Learning Models.

Parameters	VGG-19		Inception V3		ResNet50V2	
	Without Augmentation	With Augmentation	Without Augmentation	With Augmentation	Without Augmentation	With Augmentation
Training Accuracy	0.84	0.86	0.86	0.89	0.96	0.90
Validation Accuracy	0.75	0.79	0.83	0.91	0.90	0.91

Based on this performance analysis, ResNet shows better performance in terms of accuracy as compared to other models. Then we selected ResNet for further analysis. Final output is shown in Fig. 3 using prediction method.

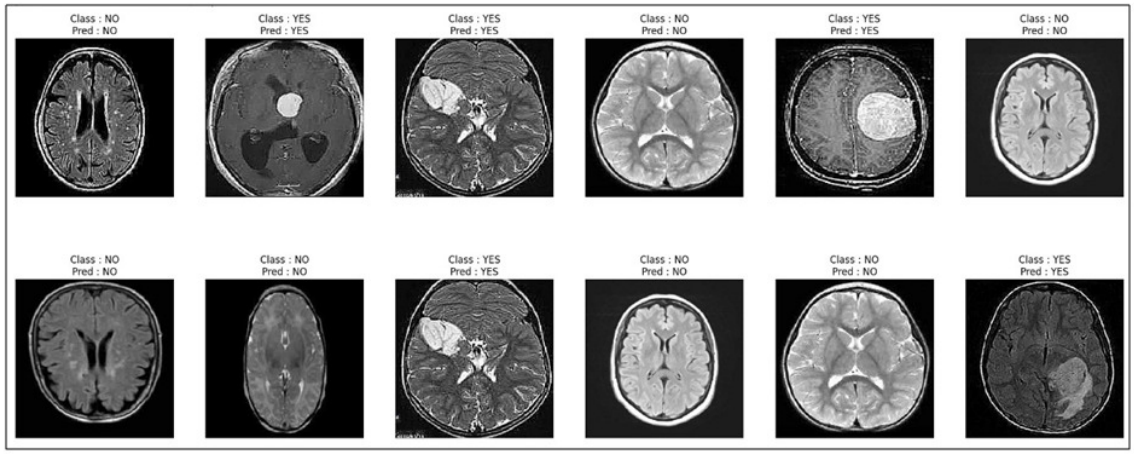

Fig. 3. Final Prediction Output.

Table 2: Performance Analysis of ResNet50V2 with different Layers.

Parameters	ResNet50V2			
	256 dense layers		64 dense layers	
	Without Augmentation	With Augmentation	Without Augmentation	With Augmentation
Training Accuracy	0.97	0.99	0.998	0.97
Validation Accuracy	0.99	0.99	0.996	0.995

Based on this different layer, ResNet with 64 dense layers shows better performance in terms of accuracy without augmentation while 356 dense layers shows better accuracy for with augmented data.

CONCLUSIONS

Deep learning has demonstrated significant potential in enhancing brain tumor diagnosis, surpassing conventional methods in both accuracy and efficiency (Majib *et al.,* 2021). The study's results demonstrate that the ResNet deep learning model attained superior accuracy in brain tumor detection relative to classic VGG and Inception approaches. This indicates that progress in deep learning for medical image analysis could significantly enhance the precision of tumor detection. The research underscores the significance of choosing the suitable deep learning architecture and evaluation measures for evaluating model performance. The findings underscore the necessity for ongoing research and development in deep learning to enhance tumor detection in medical imaging. According to this performance analysis, ResNet has superior accuracy relative to other models. Subsequently, we chose ResNet for additional examination. According to this distinct layer, ResNet with 64 dense layers demonstrates superior performance in accuracy without augmentation, whereas 356 dense layers exhibit enhanced accuracy with augmented data.

REFERENCES

Abdel-Gawad, A. H., Said, L. A., & Radwan, A. G. (2020). Optimized edge detection technique for brain tumor detection in MR images. *IEEE Access*, *8*, 136243-136259.

Amin, J., Sharif, M., Haldorai, A., Yasmin, M., & Nayak, R. S. (2022). Brain tumor detection and classification using machine learning: a comprehensive survey. *Complex & Intelligent Systems*, *8*(4), 3161-3183.

Anaya-Isaza, A., & Mera-Jiménez, L. (2022). Data augmentation and transfer learning for brain tumor detection in magnetic resonance imaging. *IEEE Access*, *10*, 23217-23233.

Chetty, H., Shah, M., Kabaria, S., & Verma, S. (2017). A survey on brain tumor extraction approach from MRI images using image processing. In *2017 2nd International Conference for Convergence in Technology (I2CT)* (pp. 534-538). IEEE.

Ejaz, K., Rahim, M. S. M., Bajwa, U. I., Chaudhry, H., Rehman, A., & Ejaz, F. (2020). Hybrid segmentation method with confidence region detection for tumor identification. *IEEE Access*, *9*, 35256-35278.

Khan, P., Kader, M. F., Islam, S. R., Rahman, A. B., Kamal, M. S., Toha, M. U., & Kwak, K. S. (2021). Machine learning and deep learning approaches for brain disease diagnosis: principles and recent advances. *Ieee Access*, *9*, 37622-37655.

Lavanyadevi, R., Machakowsalya, M., Nivethitha, J., & Kumar, A. N. (2017). Brain tumor classification and segmentation in MRI images using PNN. In *2017 IEEE international conference on electrical, instrumentation and communication engineering (ICEICE)* (pp. 1-6). IEEE.

Majib, M. S., Rahman, M. M., Sazzad, T. S., Khan, N. I., & Dey, S. K. (2021). Vgg-scnet: A vgg net-based deep learning framework for brain tumor detection on mri images. *IEEE Access*, *9*, 116942-116952.

Musallam, A. S., Sherif, A. S., & Hussein, M. K. (2022). A new convolutional neural network architecture for automatic detection of brain tumors in magnetic resonance imaging images. *IEEE access*, *10*, 2775-2782.

Noreen, N., Palaniappan, S., Qayyum, A., Ahmad, I., Imran, M., & Shoaib, M. (2020). A deep learning model based on concatenation approach for the diagnosis of brain tumor. *IEEE access*, *8*, 55135-55144.

Oksuz, I., Clough, J. R., Ruijsink, B., Anton, E. P., Bustin, A., Cruz, G., & Schnabel, J. A. (2020). Deep learning-based detection and correction of cardiac MR motion artefacts during reconstruction for high-quality segmentation. *IEEE Transactions on Medical Imaging*, *39*(12), 4001-4010.

Sahu, Y. K., Pandey, C., Biswas, P., Khan, M. R., & Rathore, S. (2020). Minimum time delay and more efficient image filtering brain tumour detection with the help of MATLAB. In *2020 International Conference on Communication and Signal Processing (ICCSP)* (pp. 1195-1199). IEEE.

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