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***Abstract*—Abstract— This paper presents a study on the application of deep learning models for the detection of brain tumors from MRI images. The goal is to develop accurate and efficient models capable of distinguishing between tumor and non-tumor regions in MRI scans. Various deep learning architectures, including VGG16, AlexNet, MobileNet, Inception, and RNN, are evaluated for their effectiveness in this task. The dataset used consists of MRI images categorized into four classes: Glioma Tumor, Meningioma Tumor, Pituitary Tumor, and No Tumor (Healthy Brain). The paper describes the methodology adopted for preprocessing the data and training the models. Additionally, a graphical user interface (GUI) is developed to facilitate visualization and interaction with the trained models. The study contributes to the field of medical image analysis by exploring the potential of deep learning techniques for automated brain tumor detection.**

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I. Introduction

Brain tumor detection is a critical task in the field of medical imaging, as timely and accurate diagnosis plays a crucial role in treatment planning and patient care. Motivated by the growing interest in utilizing deep learning techniques for medical image analysis, this paper explores the application of various deep learning models for brain tumor detection from MRI images. The contributions of this paper include the evaluation of different deep learning architectures and their performance in detecting brain tumors. The roadmap of this paper consists of an introduction to the problem, a review of related work, data description, methodology, experimental results, and conclusion.

II.RELATED WORK

Abdusalomov et al. (2024) present a comprehensive study on utilizing deep learning models for brain tumor detection from MRI images. Their approach involves a detailed methodology combining various deep learning techniques, software tools, and validation protocols to enhance the detection accuracy. The study emphasizes the importance of a well-structured methodological framework to achieve robust and reliable results. They employ convolutional neural networks (CNNs) as the primary model due to their proven effectiveness in image classification tasks. The authors also discuss the integration of data augmentation techniques to address the challenge of limited labeled data, which is a common issue in medical imaging datasets.

A significant contribution of this work is the formal analysis and rigorous validation of the proposed models. The authors highlight the critical role of extensive testing and validation to ensure the generalizability of the models to new, unseen data. Moreover, they stress the importance of writing and documenting original drafts, which aids in the reproducibility and transparency of the research. This study sets a precedent for future research by demonstrating a structured approach to developing and validating deep learning models for medical image analysis [1].

Mathivanan et al. (2024) explore the use of deep learning and transfer learning techniques to enhance the accuracy of brain tumor detection from MRI images. Their research is published in Scientific Reports and focuses on leveraging pre-trained deep learning models to address the challenges associated with training deep networks from scratch, particularly when dealing with limited medical imaging data. The authors utilize models such as VGG16, ResNet, and Inception, which are pre-trained on large-scale image datasets like ImageNet, and fine-tune them on brain MRI datasets.

The study provides a detailed comparison of various deep learning architectures and their performance metrics, showcasing the benefits of transfer learning in achieving higher accuracy with fewer computational resources. The authors report significant improvements in detection performance, attributing this to the use of advanced pre-trained models that capture rich feature representations from the images. They also highlight

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the importance of selecting appropriate hyperparameters and fine-tuning strategies to adapt the models effectively to the specific characteristics of brain MRI images.

Mathivanan et al. (2024) contribute to the field by demonstrating the practical advantages of employing transfer learning for medical image analysis. Their work provides valuable insights into the optimization of deep learning models for specific medical imaging tasks, promoting the use of advanced techniques to overcome data scarcity and computational challenges [2].

III. DATA DESCRIPTION AND PREPROCESSING STEPS

The Brain Tumor MRI Dataset consists of MRI images categorized into four classes representing different types of brain tumors. The classes and their respective names are as follows: Glioma Tumor, Meningioma Tumor, Pituitary Tumor, No Tumor (Healthy Brain). The dataset contains a total of 7022 MRI images, distributed across the classes as follows:

Glioma Tumor: 1621 images Meningioma Tumor: 1645 images Pituitary Tumor: 1757 images No Tumor (Healthy Brain): 2000 images The dataset is split into training and testing sets for model evaluation. The distribution of images in the training and testing sets is as follows:

Training Set:

Total Images: 5712 Glioma Tumor: 1321 images Meningioma Tumor: 1339 images Pituitary Tumor: 1457 images No Tumor (Healthy Brain): 1595 images Testing Set:

Total Images: 1311 Glioma Tumor: 300 images Meningioma Tumor: 306 images Pituitary Tumor: 300 images No Tumor (Healthy Brain): 405 images These datasets were subjected to preprocessing steps including normalization, and augmentation to enhance model performance and generalization.

IV. METHODOLGY

In this study, we employed five deep learning models: VGG16, AlexNet, MobileNet, Inception, and RNN. These models were trained on the MRI images to classify them into tumor and non-tumor classes. The input images were preprocessed and fed into the respective models for training. Additionally, a graphical user interface (GUI) was developed to facilitate the visualization of model predictions and provide an interactive platform for medical practitioners.

V. RESULTS

Experimental results demonstrated the efficacy of the proposed approach in brain tumor detection. The VGG16 model achieved the highest accuracy of 0.97, followed by AlexNet with an accuracy of 0.96. MobileNet achieved an accuracy of 0.8, while Inception and RNN achieved accuracies of 0.89 and 0.79, respectively. The results are summarized in Table 1 and illustrated in Figure 1.

Model	Accuracy
VGG16	0.97
AlexNet	0.96
MobileNet	0.80
Inception	0.89
RNN	0.79

TABLE I
PERFORMANCE COMPARISON OF DEEP LEARNING MODELS FOR BRAIN TUMOR DETECTION

VI. CONCLUSION

In conclusion, this paper presented a comprehensive study on the application of deep learning models for brain tumor detection from MRI images. The experimental results highlight the effectiveness of VGG16 and AlexNet in achieving high accuracy in tumor detection tasks. While MobileNet, Inception, and RNN also show promising results, further optimization and fine-tuning may enhance their performance. Overall, the findings of this study contribute to the growing body of research on leveraging deep learning for medical image analysis.

REFERENCES

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