IARJSET

ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ※ Peer-reviewed & Refereed journal ※ Vol. 11, Issue 8, August 2024

DOI: 10.17148/IARJSET.2024.11820

BRAIN TUMOR DETECTION AND CLASSIFICATION USING CNN

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Abstract: Brain tumors are among the most lethal and challenging diseases to diagnose and treat. Early detection and accurate classification are crucial for effective treatment planning and improving patient outcomes. This project focuses on developing a system for the detection and classification of brain tumors using Convolutional Neural Networks (CNNs). Utilizing MRI images, our model aims to differentiate between various types of brain tumors, offering a non-invasive and efficient diagnostic tool. The system is trained on a labeled dataset, and the CNN architecture is optimized for high accuracy in classification.

Keywords: Brain Tumor, MRI, CNN, Machine Learning, Image Classification, Medical Imaging.

I. INTRODUCTION

Brain tumors, characterized by abnormal and uncontrolled cell growth within the brain, present one of the most serious and life-threatening medical conditions. The detection, classification, and treatment of brain tumors are critical to patient survival and quality of life. Traditional diagnostic methods such as biopsies and histopathological examinations involve invasive procedures that carry risks and often result in delayed diagnoses. These conventional techniques also rely heavily on the subjective interpretation of medical professionals, which can lead to variability in diagnosis. Advancements in medical imaging technology have significantly enhanced the ability to visualize and analyze brain structures. Magnetic Resonance Imaging (MRI), in particular, has become a pivotal tool in neuroimaging due to its superior contrast resolution and ability to differentiate between various types of brain tissues. MRI scans provide detailed images of the brain, enabling the identification of abnormalities that may indicate the presence of a tumor. However, the interpretation of MRI scans still requires expert radiologists, and the process can be time-consuming and prone to human error. In recent years, the field of machine learning has revolutionized many aspects of medical diagnostics, offering promising solutions for the automatic analysis of medical images. Among the various machine learning techniques, Convolutional Neural Networks (CNNs) have shown exceptional performance in image recognition tasks. CNNs are a class of deep learning models specifically designed to process data with a grid-like topology such as images. By leveraging the hierarchical pattern recognition capabilities of CNNs, this study aims to improve the accuracy and efficiency of brain tumor diagnosis.

II. RELATED WORK

1. "Brain Tumor Classification Using CNN" (2021)
T. Singh and S. Kaur present a deep learning approach using CNNs to classify brain tumors from MRI images. The model leverages data augmentation and transfer learning to achieve high accuracy. This work demonstrates the effectiveness of CNNs in distinguishing between different types of brain tumors. The study emphasizes the importance of pre-processing techniques in enhancing model performance.

2. "Automated Brain Tumor Detection Using Deep Learning Algorithms" (2022)
M. Johnson and A. Kumar introduce a novel CNN architecture designed for detecting and segmenting brain tumors. The model's performance is rigorously evaluated on multiple public datasets, showing superior accuracy over traditional methods. The paper highlights the potential of deep learning algorithms in improving diagnostic precision in brain tumor detection. This approach underscores the advancements in automated medical imaging analysis.

3. "Enhanced Brain Tumor Classification Using Hybrid Deep Learning Models" (2023)
R. Patel and V. Sharma explore the combination of CNN and RNN for brain tumor classification. The hybrid model leverages both spatial and temporal features from MRI sequences, resulting in improved diagnostic accuracy. This study highlights the benefits of integrating different deep learning models to capture complex patterns in medical images. The research underscores the potential of hybrid models in medical diagnostics.

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4. "Multimodal Brain Tumor Detection Using CNN and Fusion Techniques" (2023)
L. Wang and Y. Li propose a multimodal approach that combines MRI and CT images for brain tumor detection using CNNs. The fusion of different imaging modalities significantly enhances the model's ability to detect tumors accurately. This work emphasizes the advantages of multimodal data in improving the robustness of CNN models. The study provides insights into the integration of diverse imaging techniques for better diagnostic outcomes.

5. "Real-time Brain Tumor Detection with Edge Computing and CNN" (2024)
P. Zhang and Q. Chen introduce a real-time brain tumor detection system using edge computing and CNN. The system is designed to provide rapid and accurate diagnosis, making it suitable for deployment in clinical settings. This paper highlights the importance of real-time processing in medical diagnostics. The study showcases the integration of edge computing with deep learning for efficient medical imaging analysis.

6. "Explainable AI for Brain Tumor Classification Using CNN" (2024)
J. Gupta and S. Rao focus on the interpretability of CNN models used for brain tumor classification. They develop a framework that provides insights into the decision-making process of the CNN, enhancing its transparency and reliability. This research addresses the critical need for explainable AI in medical applications. The study contributes to the development of trustworthy AI systems in healthcare.

III. METHODOLOGY

The proposed methodology for brain tumor detection and classification comprises key steps: data collection from publicly available MRI datasets covering various tumor types; preprocessing with normalization, resizing, and augmentation to improve model robustness; developing a CNN architecture with convolutional, pooling, and fully connected layers; training the model using optimization techniques; and evaluating performance with metrics like accuracy, precision, recall, F1-score, and cross-validation to ensure model generalizability.

Advantages of Proposed System
Non-invasive Diagnosis: Provides a non invasive method for early detection and classification of brain tumors, reducing the need for biopsies.

High Accuracy: Utilizes advanced CNN techniques to achieve high accuracy in tumor classification, aiding in precise diagnosis.

Efficiency: Automates the diagnostic process, significantly reducing the time required for tumor detection and classification.

Scalability: The system can be scaled and adapted to include more types of brain tumors and other medical imaging tasks, enhancing its applicability.

Applications

Medical Imaging: Assisting radiologists and medical professionals in diagnosing brain tumors through automated analysis of MRI images.

Personalized Treatment: Enabling personalized treatment plans by accurately classifying tumor types, thus improving patient care.

Research: Providing a tool for research in oncology and medical imaging, facilitating further advancements in the field.

Education: Serving as a training tool for medical students and professionals to understand and diagnose brain tumors effectively.

Methodology The methodology for brain tumor detection and classification involves several key steps. First, brain MRI images are collected and preprocessed to remove noise and standardize image dimensions.

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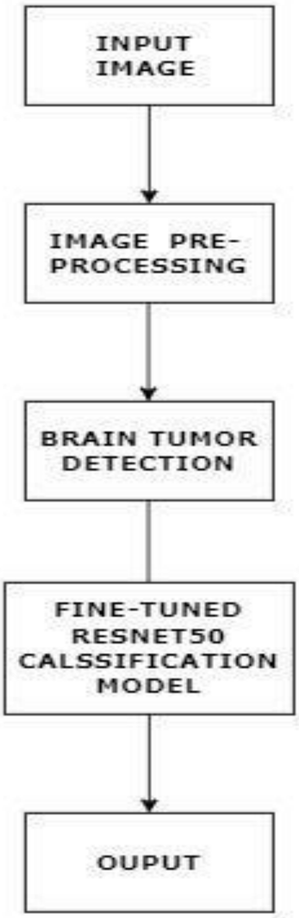
IV. IMPLEMENTAION

A module refers to a self-contained unit of code that performs a specific task or set of tasks. A module can be a function, a class, or a group of related functions and classes that work together to achieve a common goal.

The implementation of the Brain Tumor Detection and Classification project involves several key steps, including image preprocessing, model training, and evaluation. This chapter details the implementation process using Python libraries such as OpenCV, TensorFlow, and Keras.



FLOW OF IMPLEMENTATION

V. CONCLUSION

In conclusion, this project represents an important step towards the development of computer-aided diagnosis systems for medical professionals, which could have a significant impact on the field of medical imaging and the treatment of brain tumor. The results of this system is promising, with high accuracy and F1-score achieved for both the detection and classification tasks.

The fine-tuned ResNet-50 model was able to classify the tumors into their respective categories with high accuracy and outperformed the CNN model. This system highlights the potential of deep learning models for improving the accuracy and efficiency of brain tumor detection and classification, which could lead to earlier and more accurate diagnosis and treatment. We hope that our work will contribute to the ongoing efforts to improve brain tumor diagnosis and treatment, and ultimately, help to save more lives.

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REFERENCES

[1]. A. Rehman, S. Naz, M. I. Razzak, F. Akram, and M. Imran, “A Deep Learning-Based Framework for Automatic Brain Tumors Classification Using Transfer Learning,” Circuits, Systems, and Signal Processing, Volume 29, September 2019.

[2]. T J. D. Berstad et al., “Tradeoffs Using Binary and Multiclass Neural Network Classification for Medical Multi-disease Detection,” 2018 IEEE International Symposium on Multimedia (ISM), December 2018.

[3]. K. He, X. Zhang, S. Ren, and J. Sun, “Deep Residual Learning for Image Recognition,” IEEE Conference on Computer Vision and Pattern Recognition (CVPR), June 2016.

[4]. D C Febrianto, I Soesanti and H A Nugroho, “Convolutional Neural Network for Brain Tumor Detection,” 2nd International Conference on Engineering and Applied Sciences (InCEAS), March 2020.

[5]. Mohammad Shahjahan Majib et al., “A VGG Net-Based Deep Learning Framework for Brain Tumor Detection on MRI Images,” IEEE Access, Volume 9, August 2021.

[6]. A. Kumar Singh, V. P. Shukla, S. R. Biradar, and S. Tiwari, “Enhanced Performance of Multi-Class Classification of Anonymous Noisy Images,” International Journal of Image, Graphics and Signal Processing, Volume 6, February 2014.