BRAIN TUMOUR DETECTION

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PROJECT OVERVIEW

The Brain Tumor Classifier is designed to identify and diagnose different types of brain tumors, utilizing advanced machine learning techniques to assist medical professionals in early detection. This early diagnosis is critical for planning effective treatment strategies, improving patient outcomes, and advancing research. Advanced imaging techniques, coupled with machine learning models like convolutional neural networks (CNNs), assist in the precise detection and classification of tumors, enabling personalized treatment plans and minimizing healthcare costs. Early detection can greatly enhance the chances of successful treatment and improve the quality of life for patients.

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PROBLEM STATEMENT

- PRIMARY GOAL:-To develop a reliable and efficient model that can accurately classify various types of brain tumors.
- SPECIFIC GOAL:-Focus on a select group of brain tumor types and their specific characteristics. Achieve high accuracy and robustness in tumor detection. Develop a scalable model that can be expanded to include more tumor types and variations in the future.

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DATASETS

- Dataset 1:-Sourced from Kaggle, combining Figshare, SARTAJ, and Br35H datasets, this collection contains 7,023 MRI images across four classes (glioma, meningioma, no tumor, pituitary). Images vary in size and require preprocessing (resizing, cropping, marginal erasing) for tasks like tumor detection, classification (malignant/benign), and localization.
- Dataset 2:-Downloaded from Mendeley Data, the Bangladesh Brain Cancer Dataset includes 6,056 MRI images (512×512 pixels) categorized into glioma, meningioma, and brain tumor classes, designed to support machine learning model development with a moderate dataset size (~148 MB).

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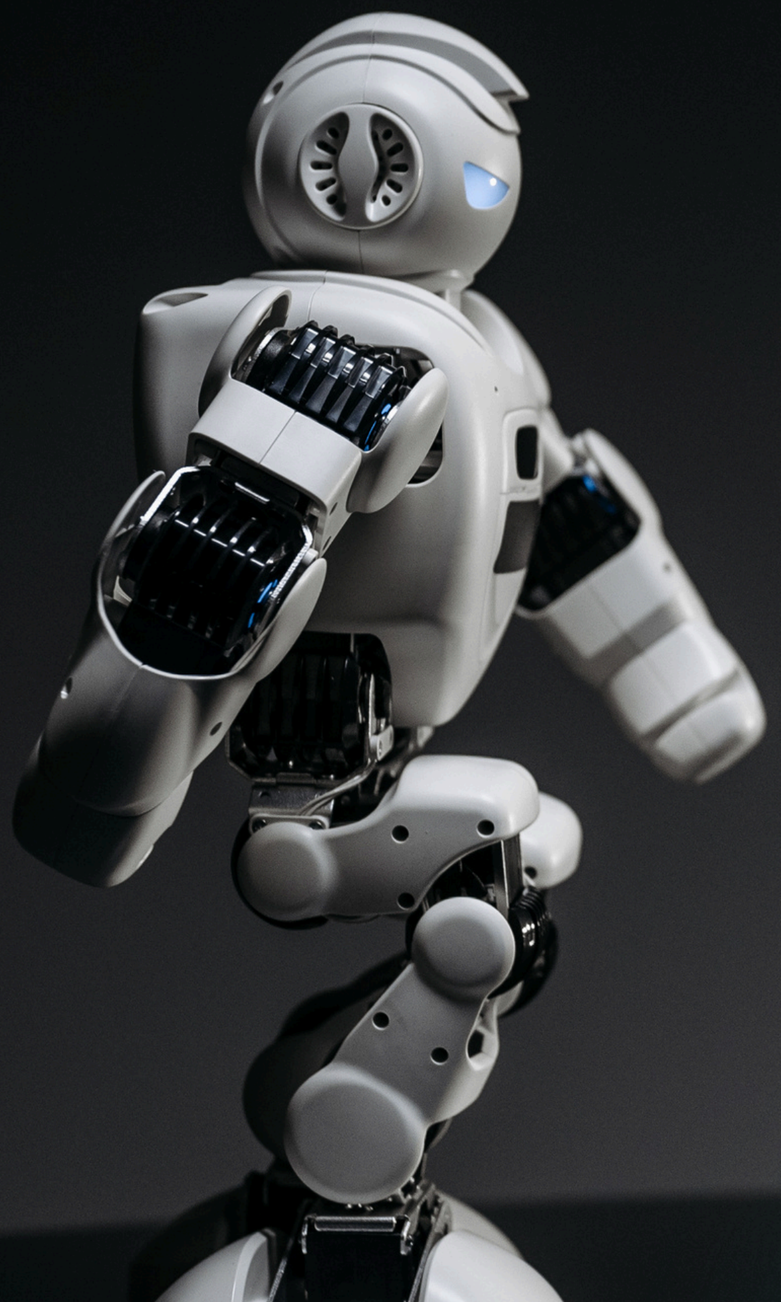

PROJECT SCOPE

The project focuses on developing a deep learning-based system for brain tumor diagnosis and classification from MRI images, using U-Net for tumor segmentation and ResNet/AlexNet for tumor type classification. It involves using two public datasets, comprehensive model evaluation, and aims to support radiologists with an accurate, reliable tool for enhanced medical image analysis.

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METHODOLOGY

U-NET

U-Net segments tumors from resized, normalized MRI images using an encoder-decoder structure with skip connections.

RES-NET

ResNet50 classifies segmented tumors after heavy data augmentation, fine-tuning on three tumor classes.

ALEXNET

A smaller AlexNet variant trains on augmented MRI data, classifying tumors with reduced overfitting risks.

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PERFORMANCE METRICS

- On Dataset 1: U-Net achieved 98.25% test accuracy (Precision: 0.92, Recall: 0.91, F1-Score: 0.91), ResNet50 achieved 97.41% (Precision, Recall, F1-Score: 0.97), and AlexNet achieved 94.3% (Precision, Recall, F1-Score: 0.94).
- On Dataset 2: Only validation accuracies were calculated: U-Net (76.63%), ResNet50 (98.84%), and AlexNet (86.75%).

CONCLUSION

This project applied U-Net for tumor segmentation, ResNet for deep feature learning, and a modernized AlexNet for classification of brain tumors from MRI images. Using a majority voting ensemble method, the system improved accuracy and robustness, minimizing misclassifications. The results highlight how deep learning architectures, when combined, can significantly enhance medical image analysis and support real-world healthcare diagnostics.