B.Tech Mini-Project Presentation on Brain Tumor detection

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INTRODUCTION

- Brain tumour ranks as the 10th leading cause of death globally . Brain tumors are abnormal growths of cells within the brain, impacting approximately 2% of all adult cancers worldwide.
- The World Health Organization (WHO) reports around 400,000 cases of brain tumours worldwide, resulting in 120,000 deaths annually.
- These tumors can be benign (non-cancerous) or malignant (cancerous), with significant implications for patient health and quality of life.
- Brain tumors can cause a range of symptoms depending on their location and size, including headaches, seizures, cognitive changes, and motor deficits.

- Early detection of brain tumors is crucial for initiating timely treatment interventions and improving patient outcomes.

- An efficient method combining traditional classifiers and Convolutional Neural Networks can assist in accurate tumor segmentation without human intervention.

- Medical imaging refers to a number of techniques that can be used as non-invasive methods of looking inside the body.

- Image segmentation is a crucial and essential step in image processing which determines the success of a higher level of image processing.

OBJECTIVE

- We are going to propose an efficient and skillful method which helps in the detection of the type of brain tumor without any human assistance based on both traditional classifiers and Convolutional Neural Network.
- Brain Tumor Detection Project: We have to develop a CNN-based model for detecting brain tumors from MRI images. Collect data, build and train the model, and evaluate its performance
- We will move from brain tumor detection to brain tumor localization and segmentation.

LITERATURE REVIEW

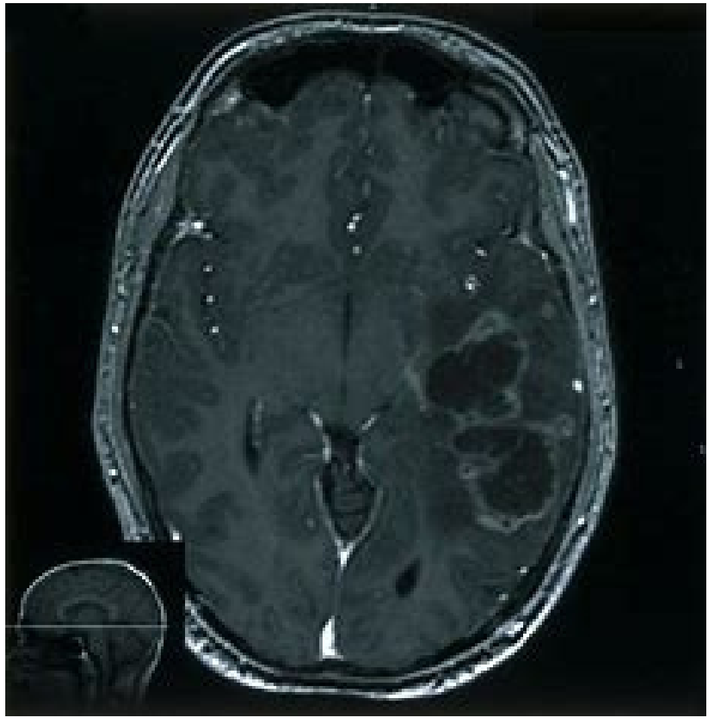
Author(s),(Year)	Goal	Method	Contribution
Tonmoy Hossain, Fairuz Shadmani Shishir, Mohsena Ashraf, MD Abdullah Al Nasim, Faisal Muhammad Shah, (2019).	The article aims to enhance brain tumor detection by merging traditional classifiers with a Convolutional Neural Network (CNN) for precise segmentation and classification of tumors from MRI images.	Convolutional Neural Network and Traditional classifiers.	This article introduces a new method for more accurate brain tumor detection from MRI images, achieving nearly 98% accuracy by combining clustering and a specialized neural network. Support Vector Machine emerged as the most effective technique, with over 92% accuracy. This research marks a significant stride towards faster and more precise brain tumor detection.
Md. Saikat Islam Khan a , Anichur Rahman , Tanoy Debnath , Md. Razaul Karim , Mostofa Kamal Nasir , Shahab S. Band , Amir Mosavi , Iman Dehzangi , (2022)	The goal of the article is to propose two deep learning models for the accurate detection and classification of brain tumors using MRI images	A 23-layers convolution neural network (CNN)	The article presents two deep learning models for brain tumor detection from MRI images: a "23-layer CNN" for large datasets and a "Fine-tuned CNN with VGG16" for smaller datasets. Both models achieve high accuracy, surpassing previous methods. The availability of datasets and source codes enhances their utility for research and clinical diagnosis.

Soheila Saeedi1, Sorayya Rezayi1*, Hamidreza Keshavarz2 and Sharareh R. Niakan Kalhori1,3 (2023)	The article aims to develop and compare deep learning and machine learning methods for diagnosing brain tumors from MRI images, with potential clinical applications.	2D Convolutional Neural Network (CNN)	The article presents a study on using deep learning and machine learning to find brain tumors in MRI images. They used a big dataset of 3264 MRI pictures to teach and test their methods. They made new networks called a 2D Convolutional Neural Network (CNN) and a convolutional auto-encoder to find tumors accurately. They also compared their methods with six other machine learning techniques and found that the CNNs worked the best. They think these networks could help radiologists find brain tumors early and accurately in hospitals.

METHODOLOGY

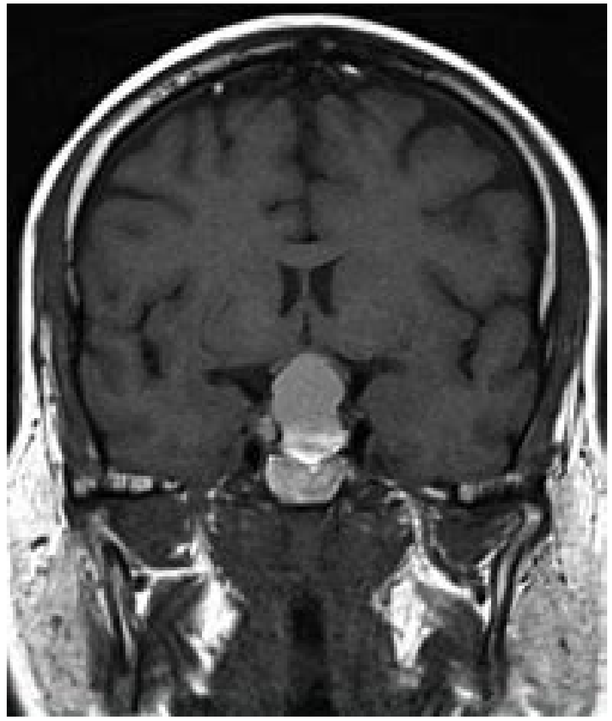
BrainTumors

Glioma Brain Tumor



Meningioma Brain Tumor

Pituitary Brain Tumor



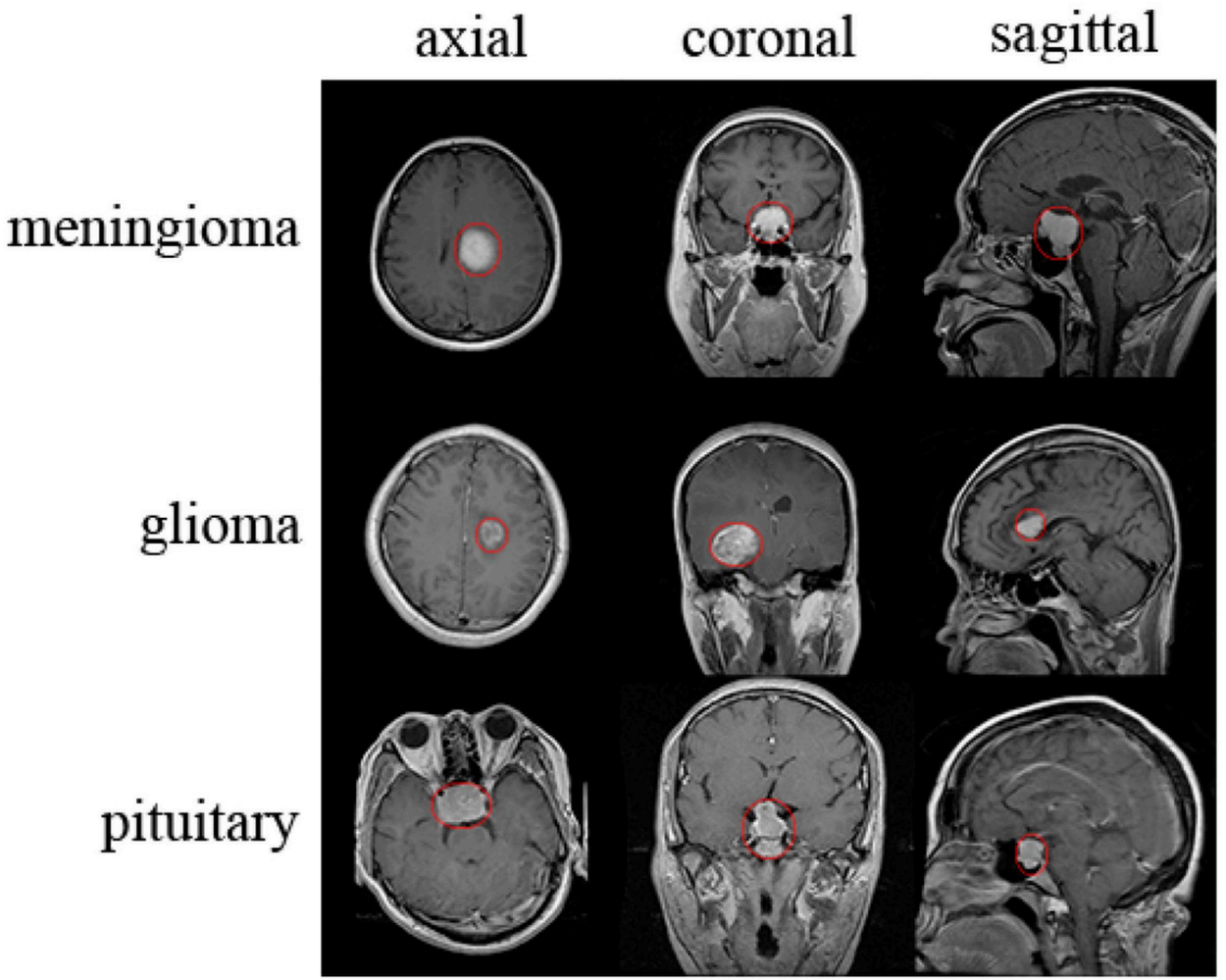
Classification of Brain tumour

There are three basic types of tumours:
1) Glioma Brain Tumor
2)Meningioma Brain Tumor
3) Pituitary Brain Tumor

Glioma Brain Tumor: Arising from glial cells, gliomas can be benign or malignant and are the most common primary brain tumors in adults.

Meningioma Brain Tumor: Derived from the meninges, these typically slow-growing tumors are more prevalent in women and often benign but can cause symptoms with growth

Pituitary Brain Tumor: Originating in the pituitary gland, these tumors may disrupt hormone production, leading to various symptoms such as headaches, vision problems, and hormonal imbalances.

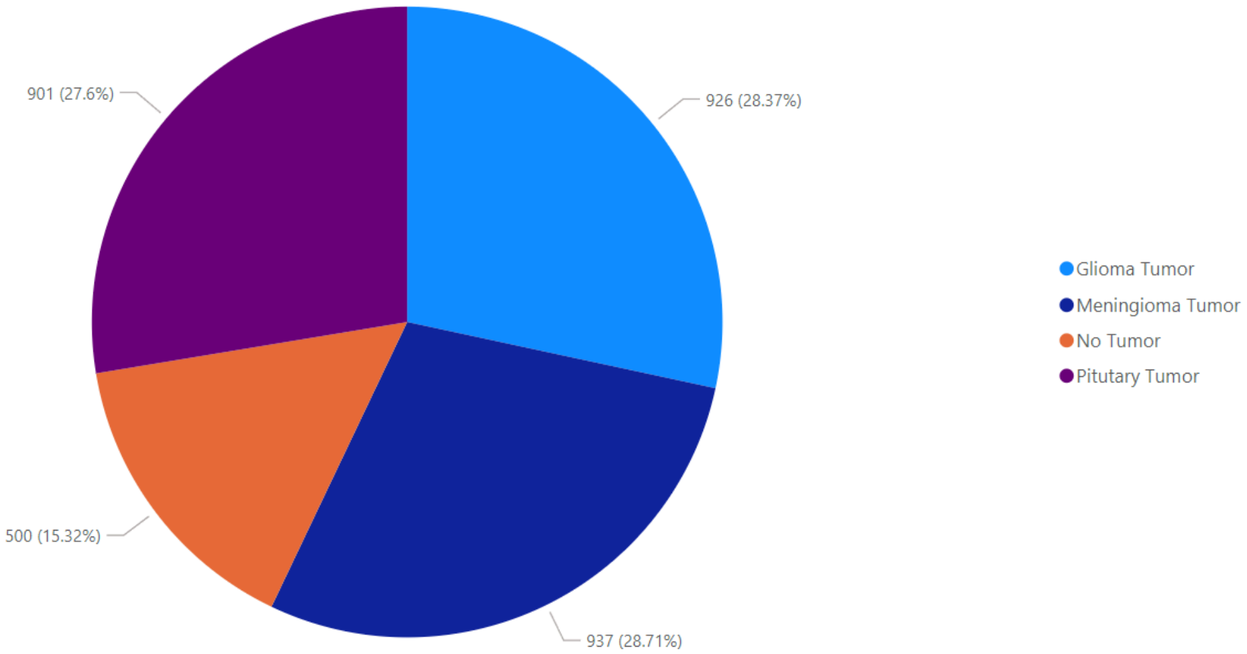


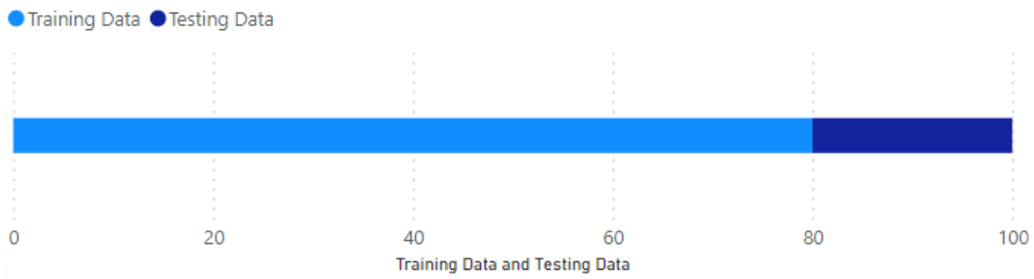
Code Implementation

- Data Preparation and Analysis
- Transfer Learning
- Confusion Matrix
- Classification Report
- Predictions

Data Preparation and Analysis

- The dataset contains 3264 MRIs. Each folder has four subfolders containing respective tumor classes.
- The original dataset was split into training and testing, using an 80 / 20 split.
- Three different input size given to all models which are 150x150x3, 224x224x3, 300x300x3.

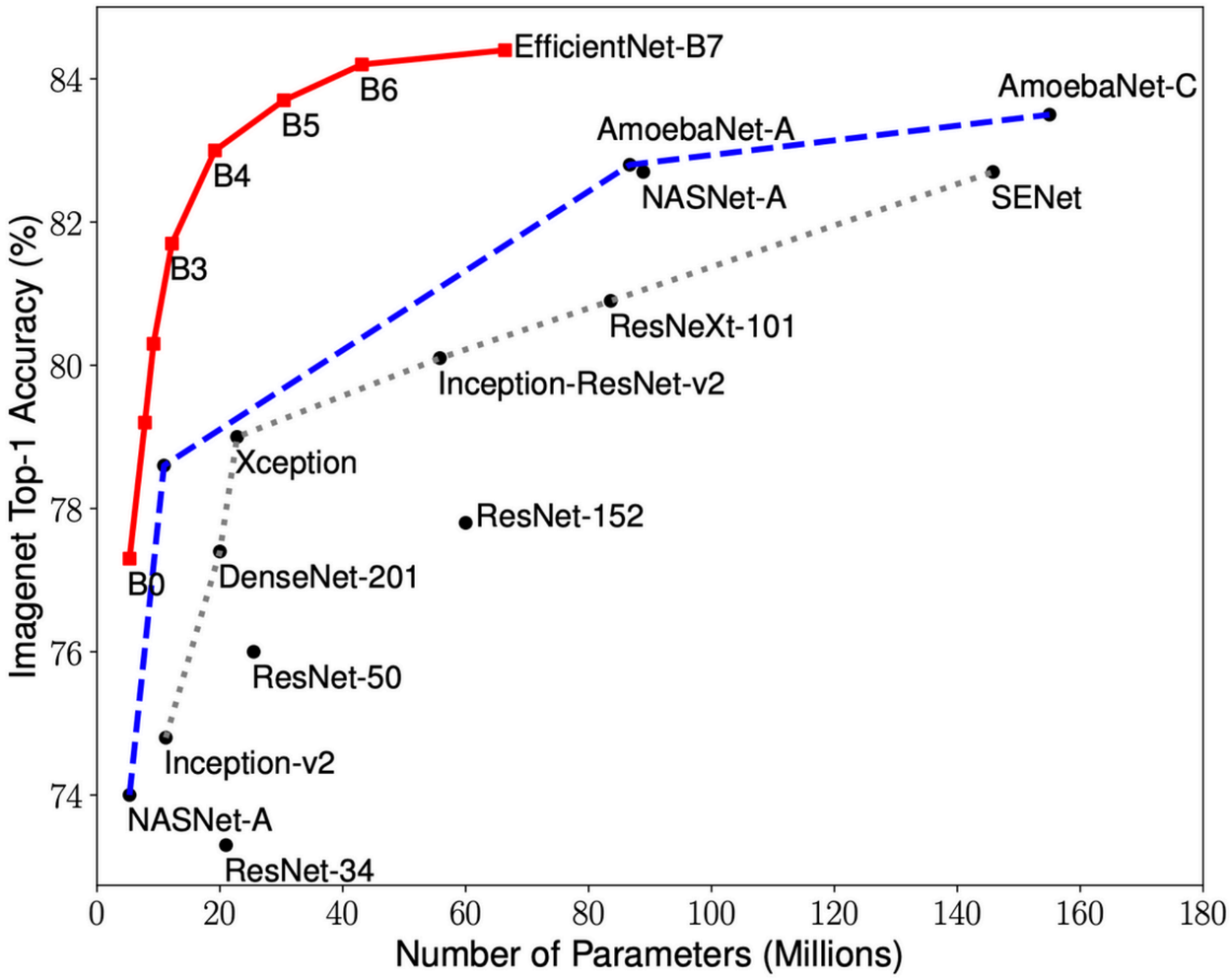




Transfer Learning

- We worked with 10 deep learning models which are DenseNet201, EfficientNetB0, EfficientNetB4, EfficientNetV2M, InceptionV3, MobileNetV3L, ResNet50, VGG16, VGG19, and Xception.

- Out of all these models, EfficientNetV2M gave the best results.

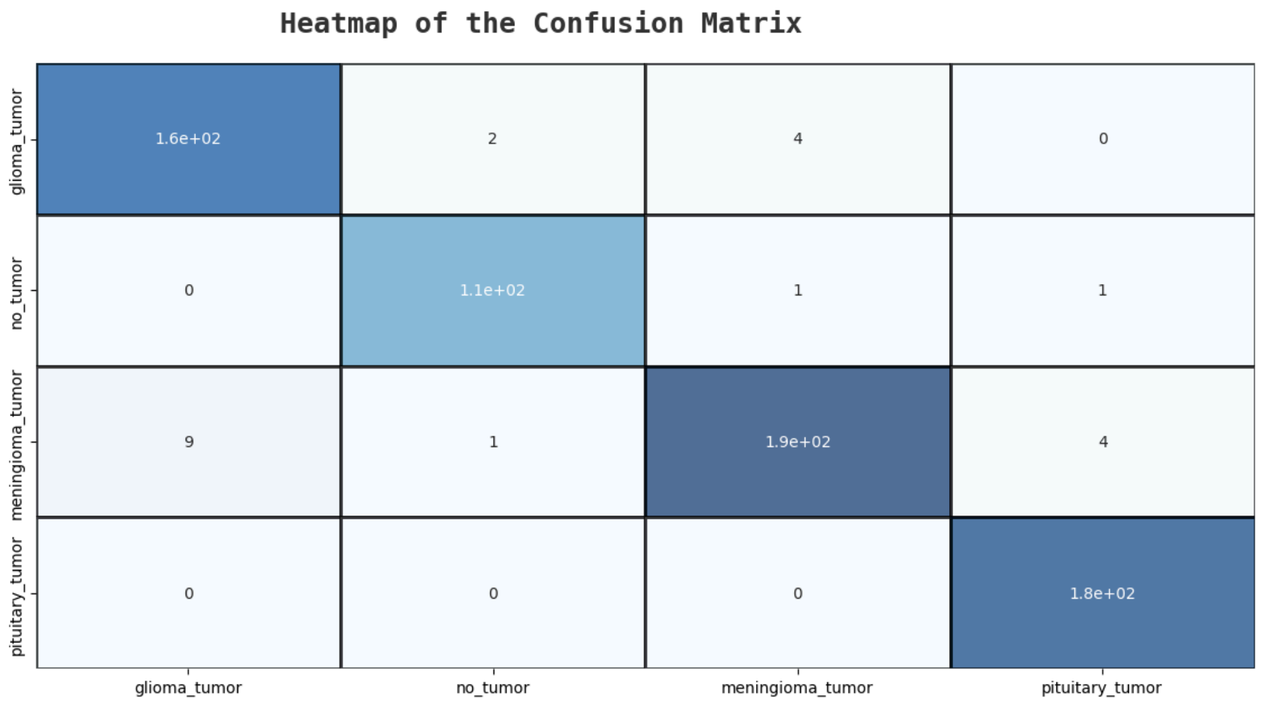


Source: Kaggle

Confusion Matrix

- A confusion matrix is a matrix that summarizes the performance of a machine learning model on a set of test data.

- It helps calculate the model's recall, accuracy, precision, and f1-score.



Classification Report

- This is the summary of the quality of classification made by the constructed ML model.

- The first column is the class label’s name, followed by Precision, Recall, F1-score, and Support.

	precision	recall	f1-score	support
glioma_tumor	0.95	0.96	0.96	168
no_tumor	0.97	0.98	0.98	108
meningioma_tumor	0.97	0.93	0.95	201
pituitary_tumor	0.97	1.00	0.99	176
accuracy			0.97	653
macro avg	0.97	0.97	0.97	653
weighted avg	0.97	0.97	0.97	653

Predictions

- Random images selected from the testing data set for the predictions.

- The actual label, predicted label, and confidence rate were printed.

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1/1 ━━━━━━━━━━━━━━━━━━━━ 5s 5s/step
Predicted label: meningioma_tumor
Actual label: meningioma_tumor
Confidence: 100.00%
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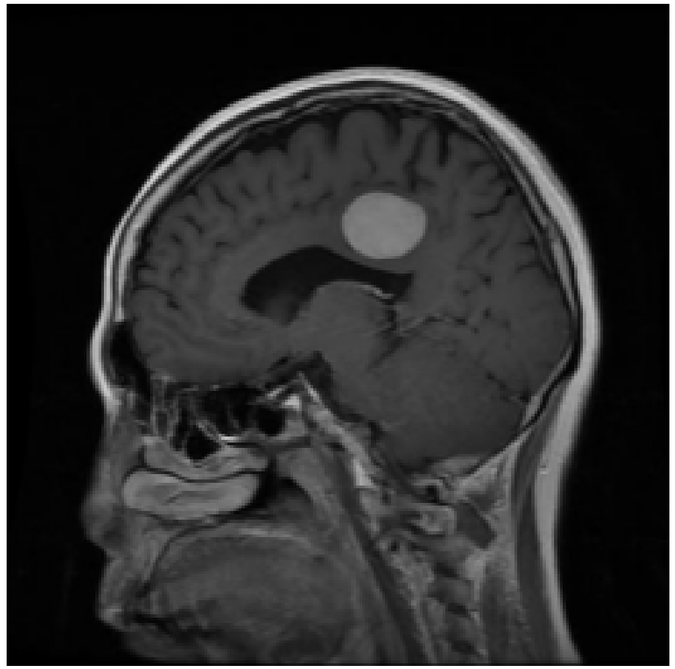
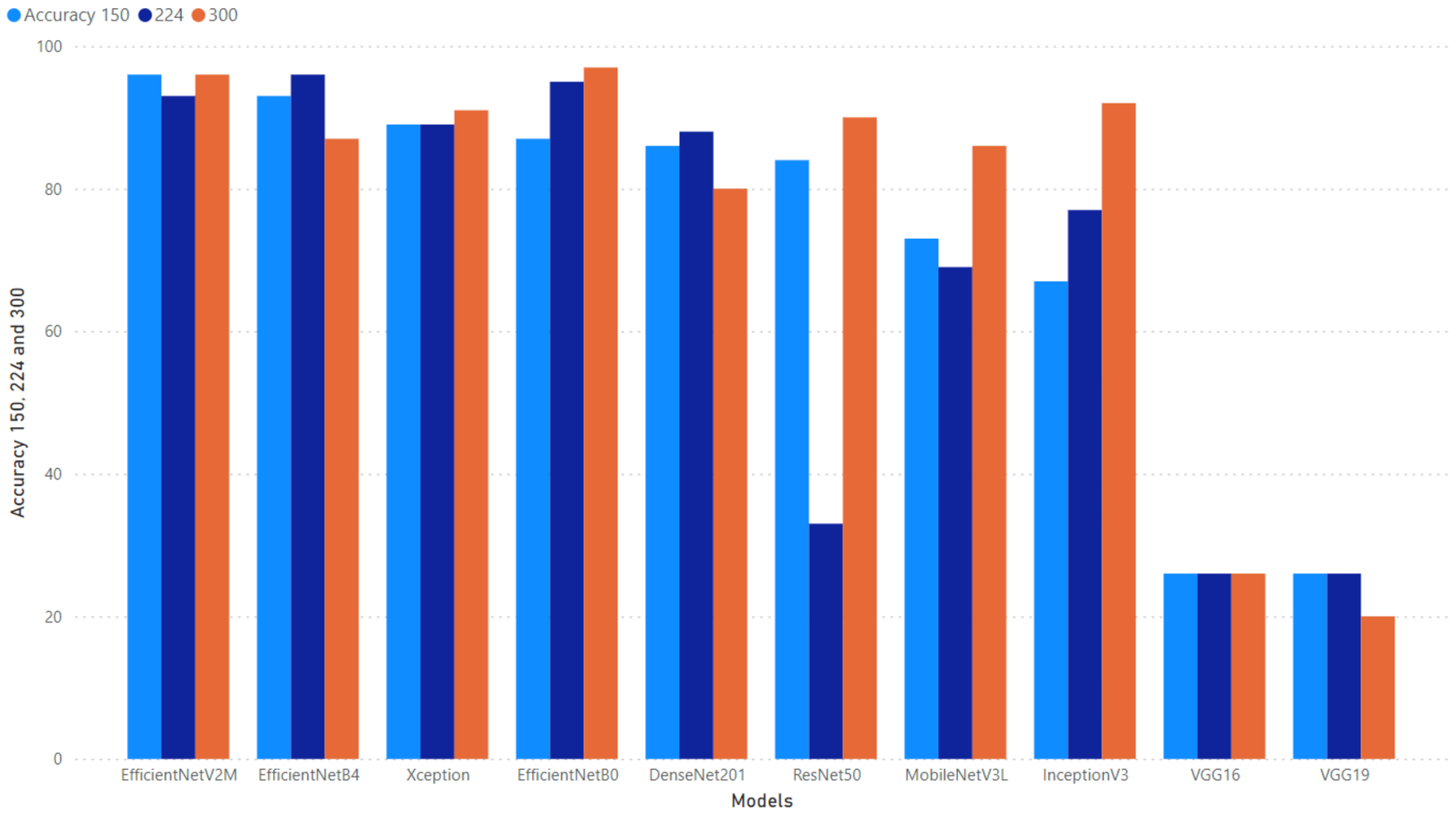


Comparative Analysis



Comparative Analysis

- EfficientV2M gave more than 90% accuracy in all input sizes.
- EfficientNetB4 gave more than 90% accuracy for input sizes 150x150x3 and 224x224x3.
- EfficientNetB0 gave more than equal 95% accuracy for input sizes 224x224x3 and 300x300x3.
- EfficientNetV2M, EfficientNetB4, Xception, EfficientNetB0, and DenseNet201 gave an accuracy of more than equal to 80% in all input sizes.
- VGG16 and VGG19 performed poorly in all input sizes.

REFRENCES

[1] Hany Kasban, Mohsen El-bendary, Dina Salama. (2015). "A Comparative Study of Medical Imaging Techniques". International Journal of Information Science and Intelligent System, 4, 37-58.

[2] Deep Learning for Computer Vision by Rajalingappaa Shanmugamani - This book specifically focuses on deep learning techniques for computer vision tasks, including CNN architectures and their applications in image classification and object detection.

[3] A Review on Brain Tumor Detection and Classification Using Machine Learning Techniques" by R. Priya and K. Saruladha - This review article summarizes various machine learning techniques applied to brain tumor detection and classification, providing insights into the state-of-the-art methods.

[4] Kavitha Angamuthu Rajasekaran and Chellamuthu Chinna Gounder,Advanced Brain Tumour Segmentation from MRI Images, 2018.

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