

BRAIN TUMOR VISION AI

AI - Powered Deep Learning System for Brain Tumor
Prediction and Classification Using MRI Images

Ai

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Problem Statement

Brain tumor detection from MRI scans is slow and requires expert radiologists. Manual diagnosis may cause delays, variation, and human error.

Common dataset issues in MRI classification:

- Class imbalance
- Incorrect train–test splits
- Mixed data distributions
- Unclean/noisy validation images

 **How to automatically detect and classify types of brain tumors using AI & deep learning with high accuracy, reliability, and clinical usefulness?**

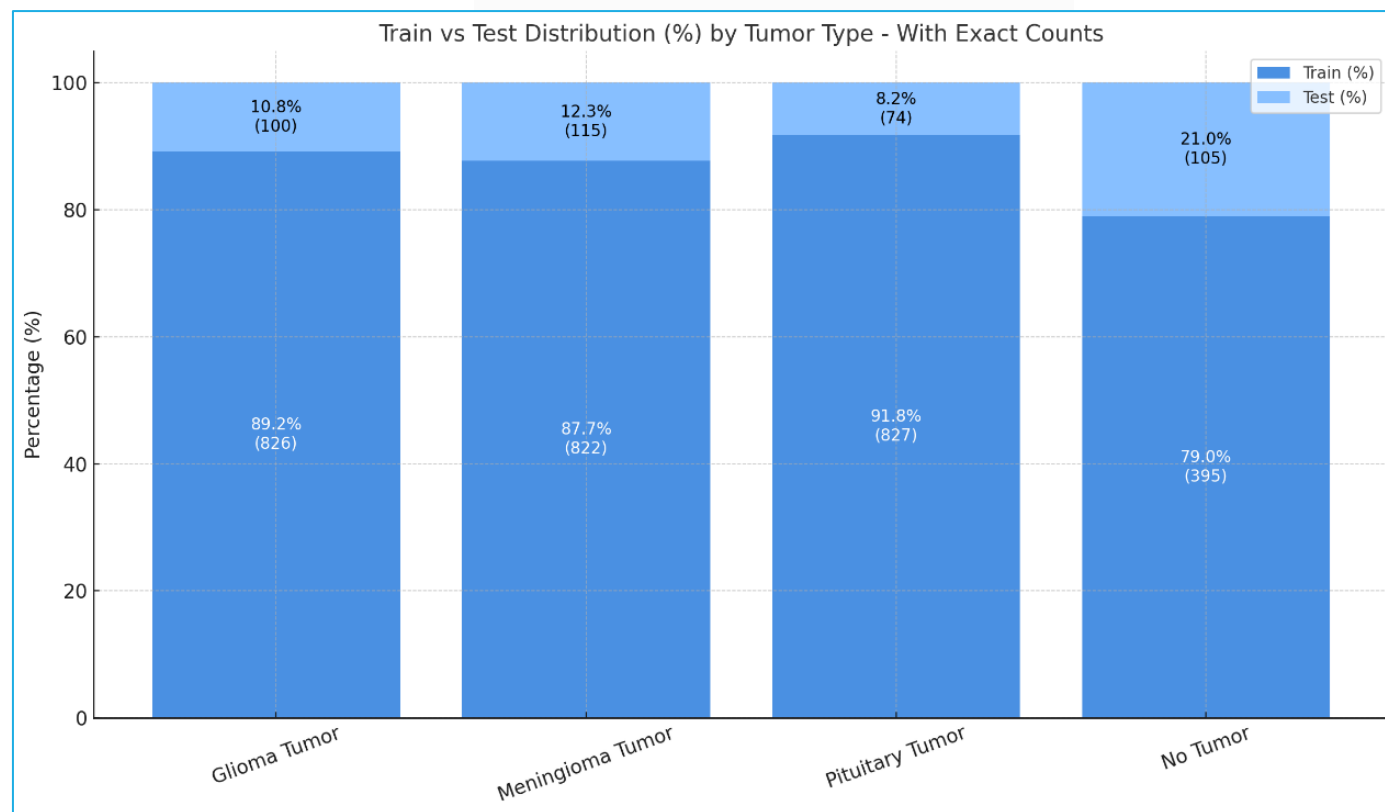
Dataset Preparation

Kaggle Dataset: A publicly available Brain MRI Tumor Dataset was downloaded from Kaggle:
<https://www.kaggle.com/datasets/masoudnickparvar/brain-tumor-mri-dataset>

Brain Tumor MRI Dataset Summary (Kaggle)

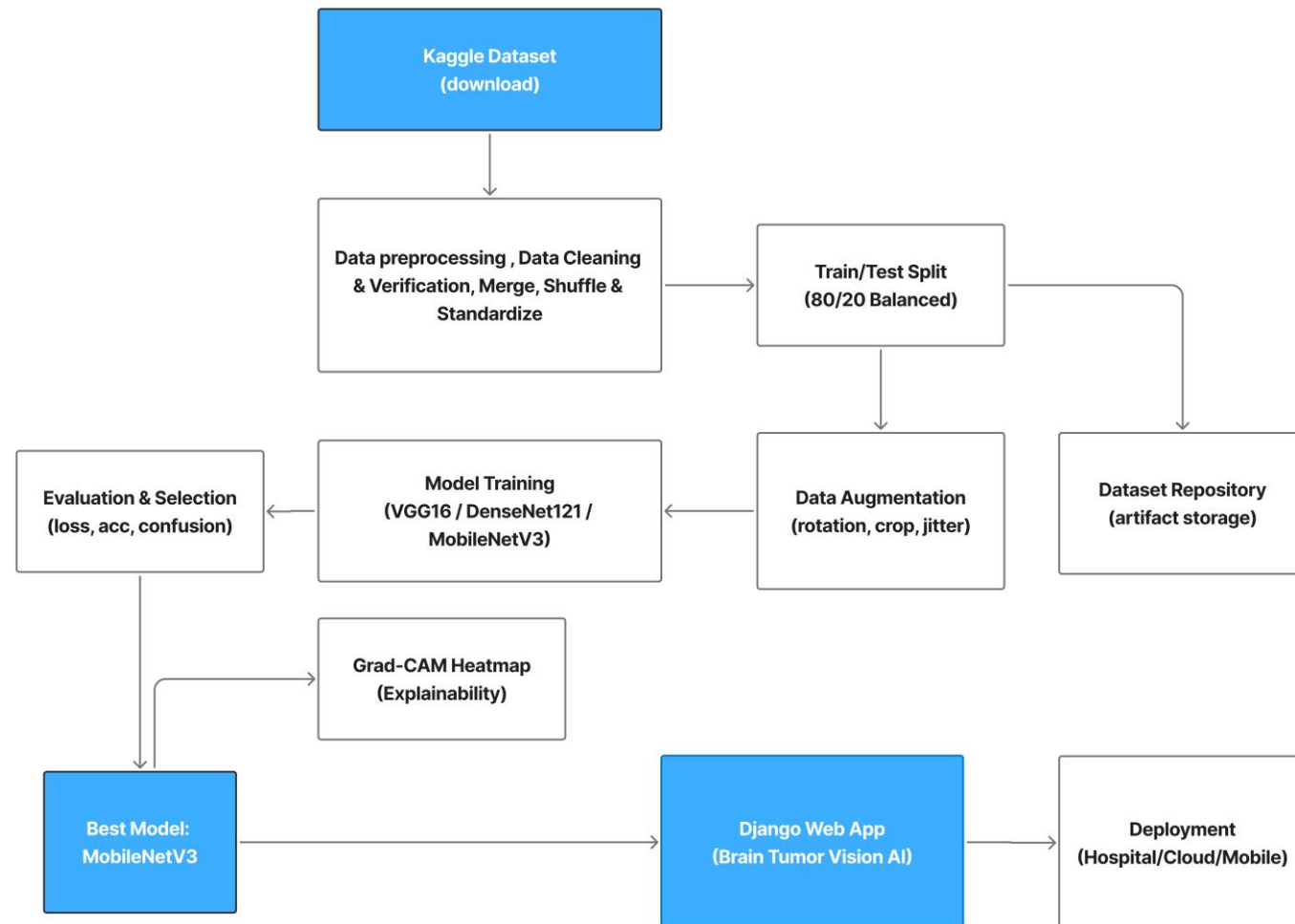
Tumor Type	Train Images	Test Images	Total Images
Glioma Tumor	826	100	926
Meningioma Tumor	822	115	937
Pituitary Tumor	827	74	901
No Tumor	395	105	500
Total	2870	394	3264

MRI Dataset Train–Test Distribution by Tumor Type



System Architecture and methodology workflow

Brain Tumor Vision AI



Data Preprocessing

The initial Kaggle MRI dataset was **highly imbalanced**

■ Before dataset imbalanced

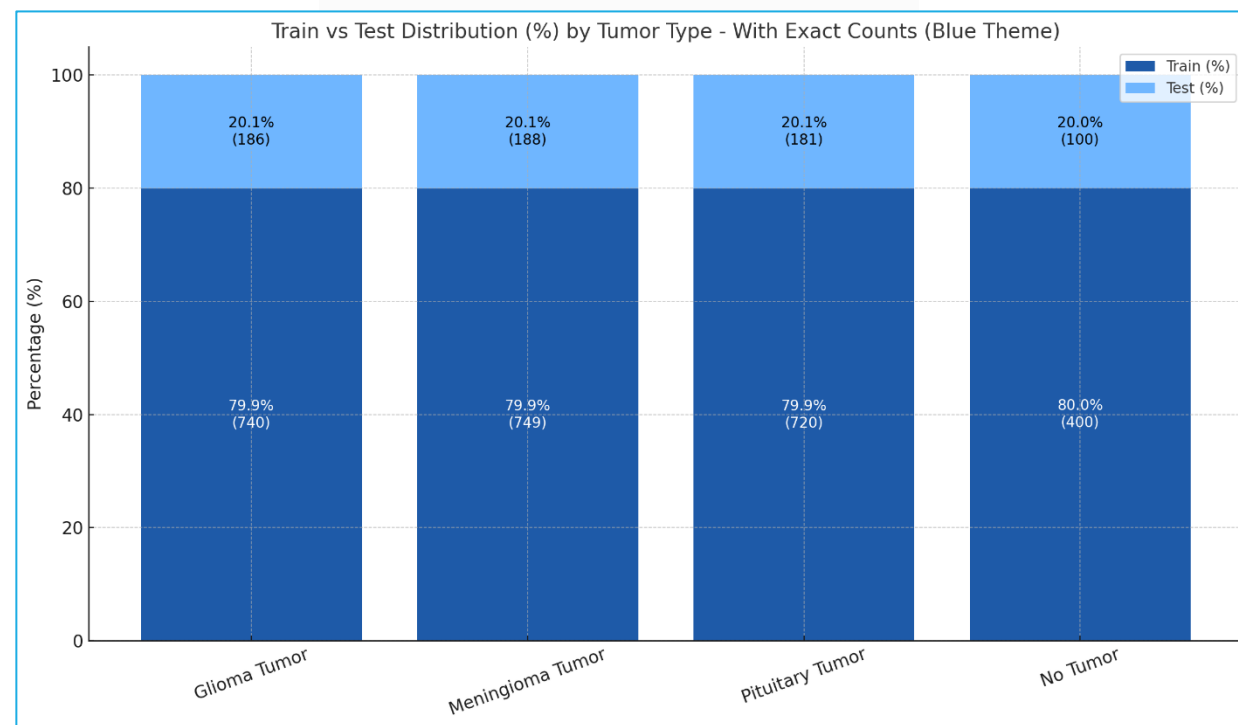
- Overfitting with unstable validation accuracy
- High training accuracy but low validation accuracy (46–78%)
- Validation images had a different distribution from training images
- Uneven or incorrect train–test splits
- Significant class imbalance across tumor categories

■ After dataset balanced

- All MRI images were **verified, cleaned, and standardized**
- Original **train and test folders were merged** to ensure uniform distribution
- The full dataset was **shuffled** to remove ordering bias
- A new **balanced 80/20 train–test split** was generated
- Class imbalance and distribution mismatches were fully corrected

Balanced dataset

Tumor class	Train (80%)	Test (20%)	Total
Glioma Tumor	740	186	926
Meningioma Tumor	749	188	937
Pituitary Tumor	720	181	901
No Tumor	400	100	500
TOTAL	2609	655	3264



Model Selection & Training

Convolutional Neural Networks (CNNs) were selected for this project because they are the state-of-the-art architecture for medical image analysis.

Three widely used CNN architectures were evaluated

Model	Reason for Selection
VGG16	Classical deep CNN architecture, well-known for strong feature extraction and baseline benchmarking.
DenseNet121	Efficient gradient flow, dense layer connectivity, and high feature reuse-often achieves strong performance on medical datasets.
MobileNetV3-Large	Lightweight, fast, optimized for real-time inference, and ideal for deployment on CPU/GPU environments.

Each model was trained using:

- **Transfer Learning** with pretrained ImageNet weights
- **Data augmentation** (rotation, cropping, jitter, flips) to improve robustness
- **Selective fine-tuning** of the deeper layers
- **Cross-entropy loss + Adam optimizer**
- **Early stopping and best-model checkpointing**

- Model performance was evaluated using:
 - **Training loss**
 - **Validation loss**
 - **Validation accuracy**
 - **Generalization behavior across epochs**

Model Comparison

Model Performance Summary (VGG16, DenseNet121 and MobileNetV3)

Model	Dataset Condition	Best Validation Accuracy	Best Validation Loss	Notes
VGG16	Original (Imbalanced)	71.32%	15.19	Heavy, slow on CPU, high overfitting, weak generalization
DenseNet121	Original (Imbalanced)	70.56%	1.0570	High-capacity but sensitive to imbalance; requires clean data
MobileNetV3-Large (Before Fix)	Imbalanced Dataset	78.93%	0.6159	Good architecture but limited by dataset mismatch
MobileNetV3-Large (After Balanced Dataset)	Balanced + Shuffled Dataset	95.11%	0.2096	Best model: fast, stable, high accuracy, no overfitting, strong generalization
Grad-CAM	Balanced + Shuffled Dataset			Shows tumor region

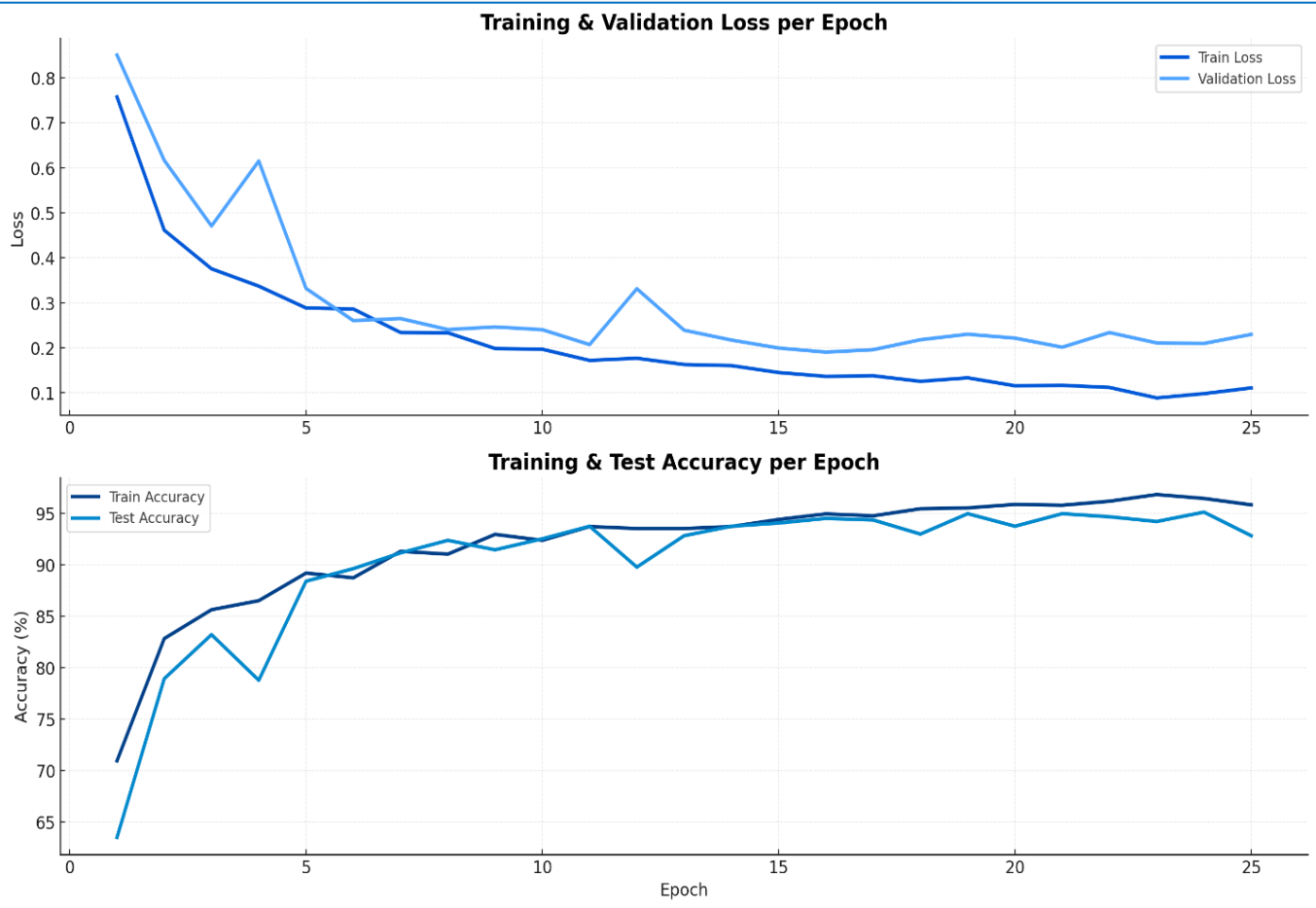
Model Comparison

MobileNetV3 Performance: Both losses and a consistent rise in accuracy, indicating stable learning, minimal overfitting, and strong generalization.

MobileNetV3 Performance Comparison
– Before vs After Dataset Balancing

Metric	Before (Imbalanced Dataset)	After (Balanced Dataset)	Improvement
Best Train Epoch	22	24	
Train Loss	0.5038	0.0980	↓ Major improvement
Train Accuracy	83.51%	96.44%	↑ +12.93%
Validation Loss	0.6159	0.2096	↓ Stronger generalization
Validation Accuracy	78.93%	95.11%	↑ +16.18%
Generalization	Poor - Overfitting	Excellent - Balanced learning	Dramatic improvement
Dataset Quality	Unbalanced & mismatched	Clean, shuffled, balanced	Fixed distribution

Training & Validation Loss and Accuracy Curves for MobileNetV3-Large



Conclusion & Deployment

This project successfully developed **Brain Tumor Vision AI**, an end-to-end deep-learning system capable of accurately detecting and classifying brain tumors from MRI scans with **95.11% accuracy** using MobileNetV3-Large. Dataset balancing and preprocessing were key to high performance. Grad-CAM enabled clinical interpretability

Deployment:

- ✓ Django Web Application
- ✓ MRI Upload → Preprocess → Predict → Heatmap
- ✓ Fast, accurate, explainable diagnostic support tool

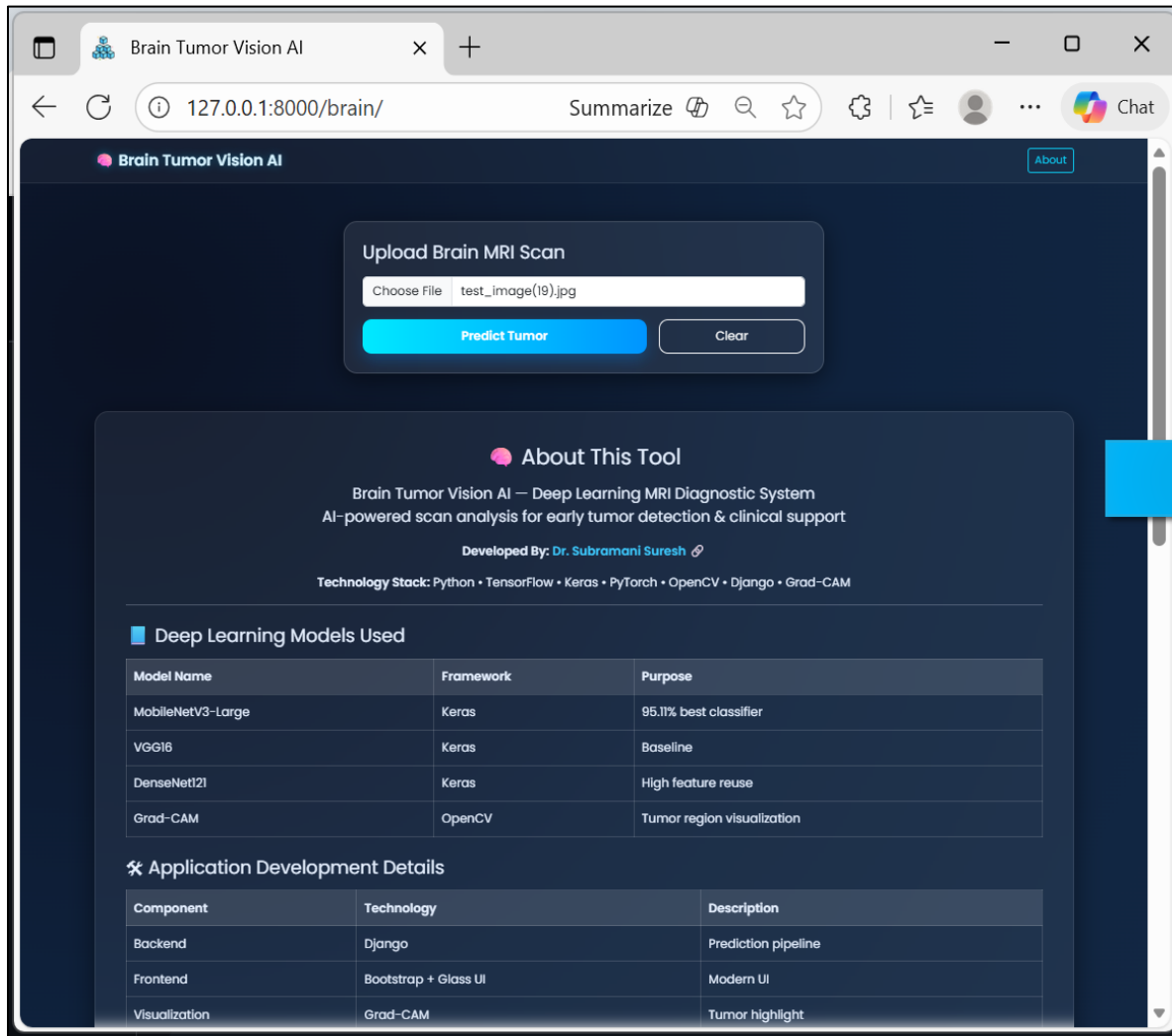
Final Output Example:

- **Tumor / No-Tumor detection**
- **Predicted Class** (Glioma, Meningioma, Pituitary, No Tumor)
- **Ai Confidence Score**
- **Grad-CAM heatmap**: highlight suspected tumor regions

Tech Stack

Component	Technology	Description
Backend / API	Django (Python)	Handles image upload, processing, and inference
Frontend	HTML, CSS, Bootstrap	Clean and responsive UI
Model Integration	PyTorch	Loads best MobileNetV3 model for prediction
Visualization	Grad-CAM + OpenCV	Generates heatmaps for interpretability
Deployment	Django Web Application	Runs on CPU/GPU; suitable for labs and hospitals

Brain Tumor Vision AI - Result



Brain Tumor Vision AI

Upload Brain MRI Scan

Choose File test_image(10).jpg

Predict Tumor Clear

About

About This Tool

Brain Tumor Vision AI — Deep Learning MRI Diagnostic System
AI-powered scan analysis for early tumor detection & clinical support

Developed By: [Dr. Subramani Suresh](#)

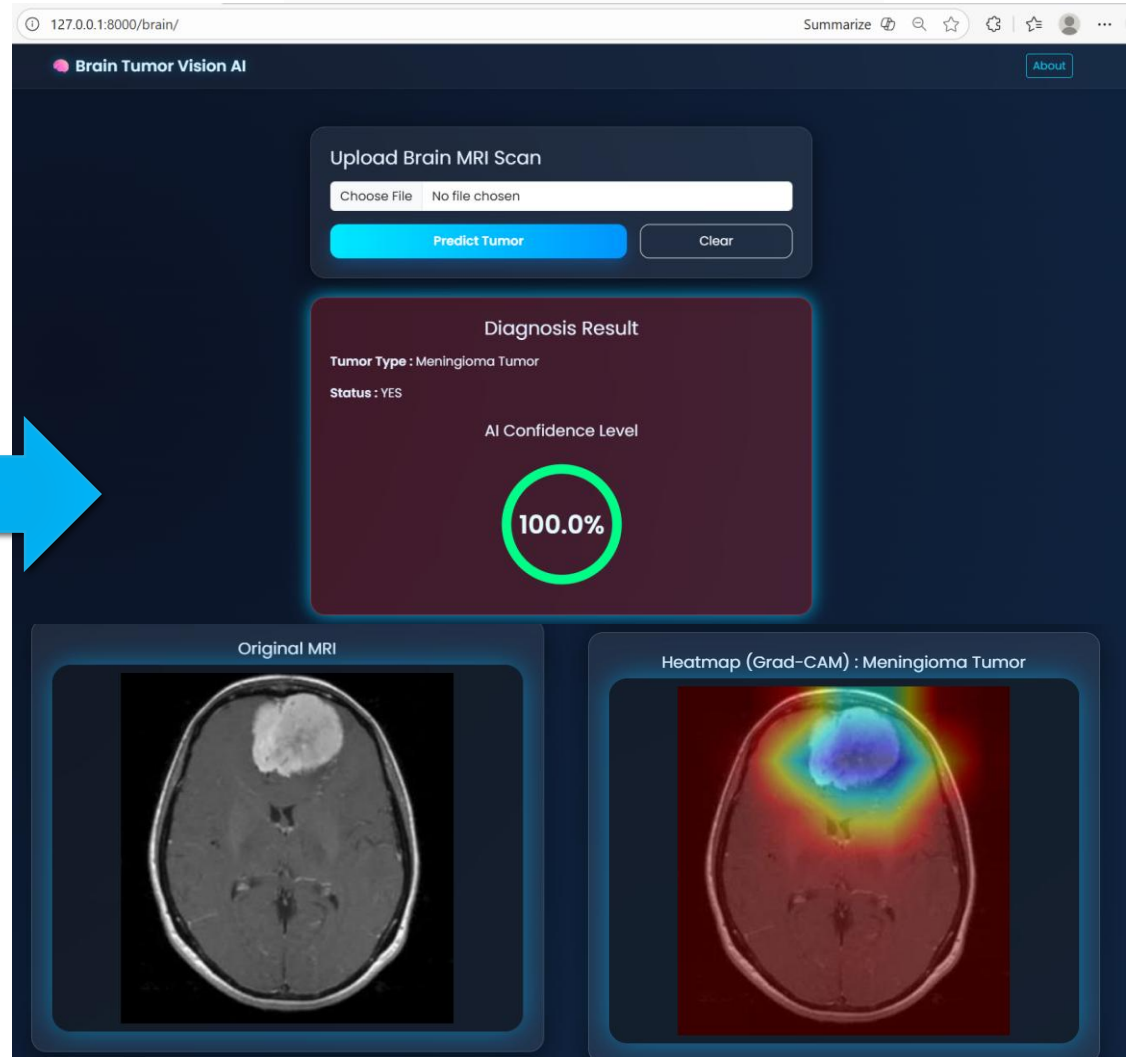
Technology Stack: Python • TensorFlow • Keras • PyTorch • OpenCV • Django • Grad-CAM

Deep Learning Models Used

Model Name	Framework	Purpose
MobileNetV3-Large	Keras	95.11% best classifier
VGG16	Keras	Baseline
DenseNet121	Keras	High feature reuse
Grad-CAM	OpenCV	Tumor region visualization

Application Development Details

Component	Technology	Description
Backend	Django	Prediction pipeline
Frontend	Bootstrap + Glass UI	Modern UI
Visualization	Grad-CAM	Tumor highlight



Brain Tumor Vision AI

Upload Brain MRI Scan

Choose File No file chosen

Predict Tumor Clear

Diagnosis Result

Tumor Type : Meningioma Tumor

Status : YES

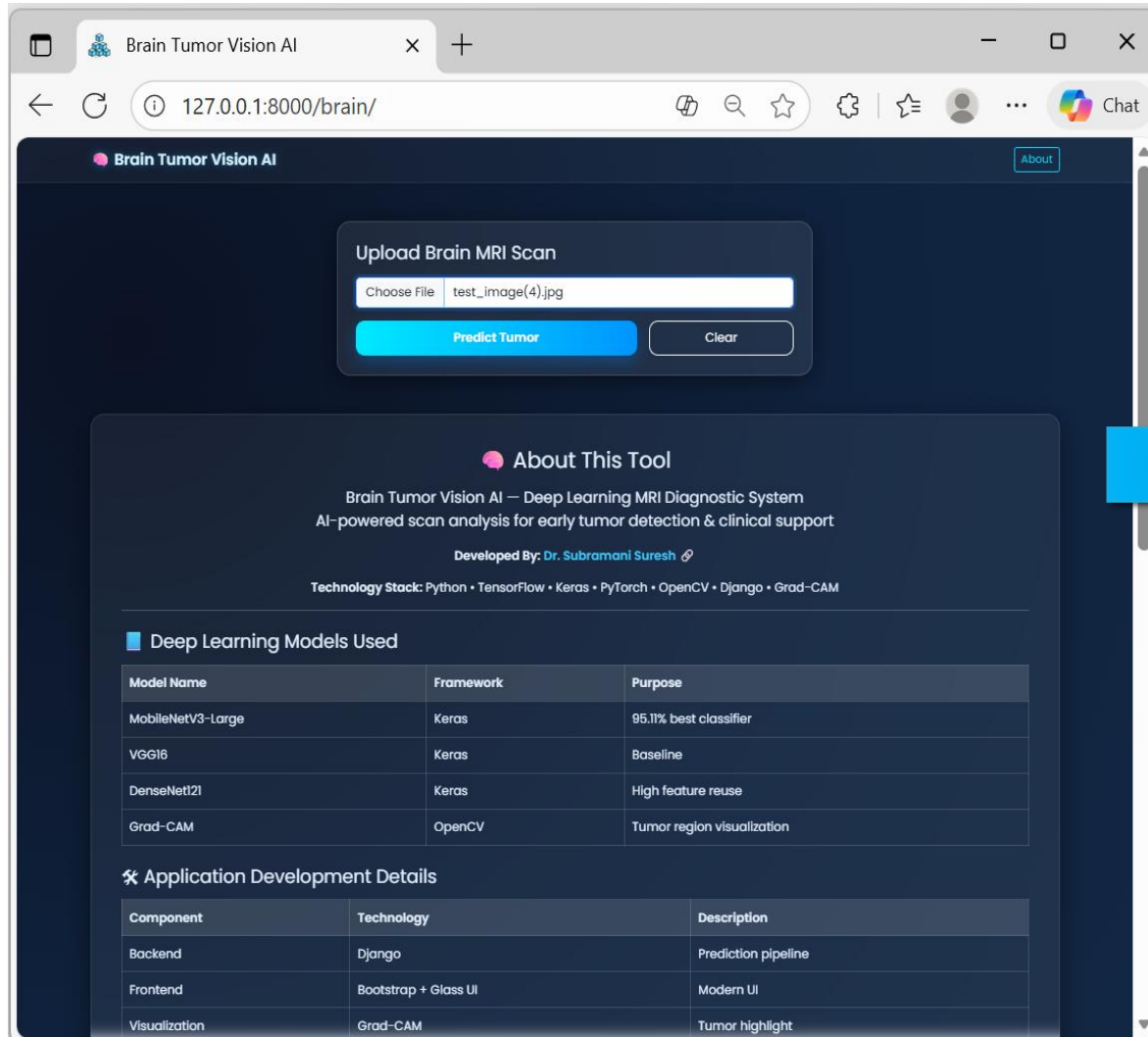
AI Confidence Level

100.0%

Original MRI

Heatmap (Grad-CAM) : Meningioma Tumor

Brain Tumor Vision AI - Result

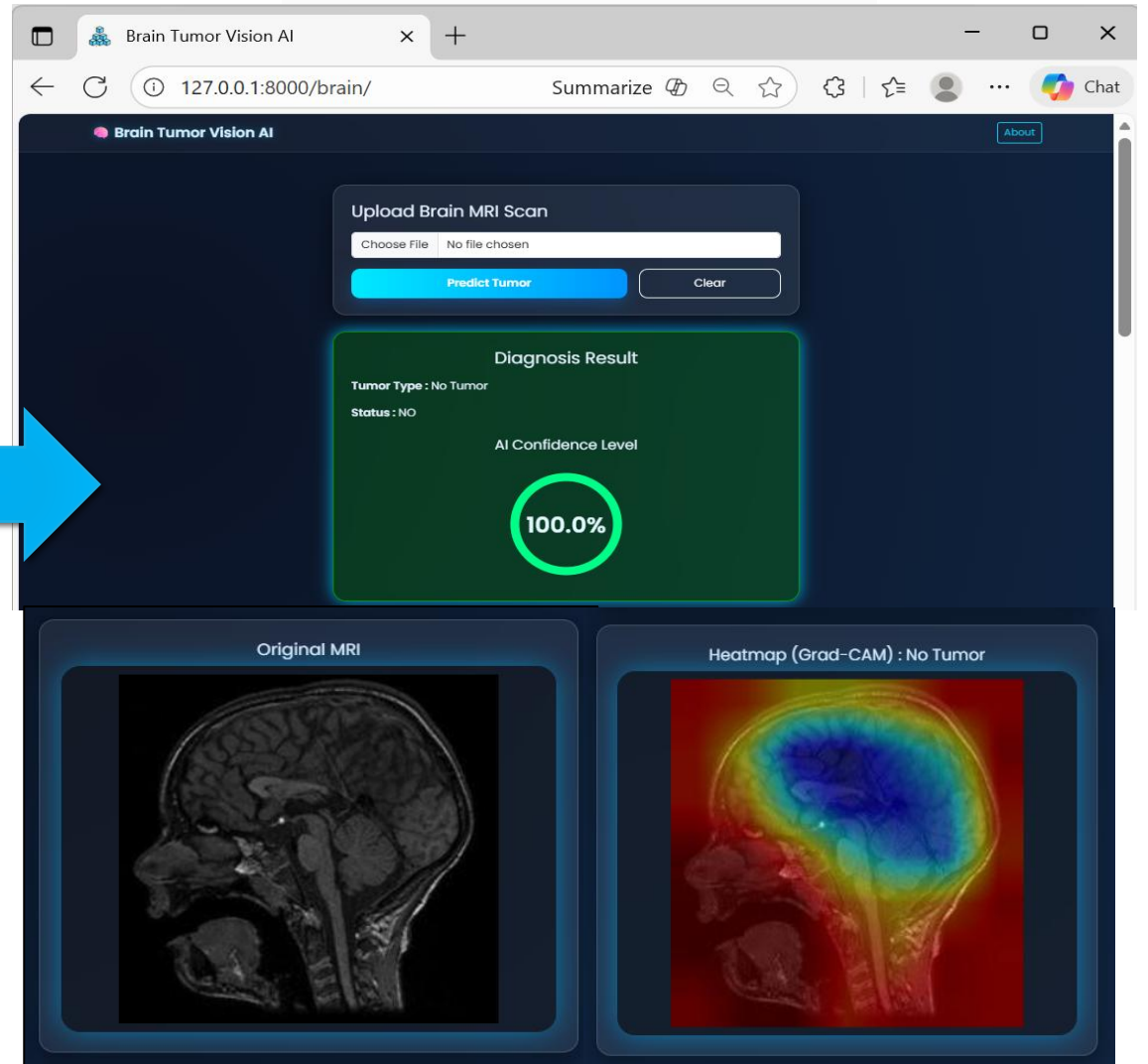


The screenshot shows the 'Brain Tumor Vision AI' web application. At the top, there's a navigation bar with the app name and an 'About' button. Below it, the 'Upload Brain MRI Scan' section features a 'Choose File' button, a text input field containing 'test_image(4).jpg', a 'Predict Tumor' button, and a 'Clear' button. The main content area is titled 'About This Tool' and describes the system as a 'Deep Learning MRI Diagnostic System'. It lists the developer as 'Dr. Subramani Suresh' and the technology stack: Python, TensorFlow, Keras, PyTorch, OpenCV, Django, and Grad-CAM. Below this, a section titled 'Deep Learning Models Used' contains a table with the following data:

Model Name	Framework	Purpose
MobileNetV3-Large	Keras	95.11% best classifier
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Below the table is a section titled 'Application Development Details' with another table:

Component	Technology	Description
Backend	Django	Prediction pipeline
Frontend	Bootstrap + Glass UI	Modern UI
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The screenshot shows the 'Brain Tumor Vision AI' web application displaying the 'Diagnosis Result'. The 'Upload Brain MRI Scan' section at the top shows a 'Choose File' button, a text input field with 'No file chosen', a 'Predict Tumor' button, and a 'Clear' button. The 'Diagnosis Result' section, highlighted with a green border, displays the following information:

- Tumor Type:** No Tumor
- Status:** NO
- AI Confidence Level:** 100.0%

Below the diagnosis result, there are two image displays:

- Original MRI:** A grayscale MRI scan of a brain in sagittal view.
- Heatmap (Grad-CAM) : No Tumor:** A heatmap overlay on the MRI scan, showing a color gradient from blue (low intensity) to red (high intensity), indicating the model's focus on the brain tissue.



Thank You

