SHRI VILEPARLE KELAVANI MANDAL'S
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Permanently Affiliated to the University of Mumbai)

OMAD- Brain Tumor Detection

- Abhay Mathur - 60017210016
- Darsh Thakkar - 60017210040
- Omar Shaikh - 60017210088
- Mahir Madhani - 60017210019
- Guide: Dr. Nilesh Rathod

Presentation Outline

1.Introduction

Artificial Intelligence holds tremendous potential in revolutionizing health innovation, particularly in the field of brain tumour detection. By leveraging advanced Deep Learning algorithms and image recognition techniques, AI enhances diagnostic capabilities beyond human visual capacities, enabing automatic diagnosis from medical images, such as MRI scans.

1.1 Aim Of The Project

Our aim is to increase the accuracy of existing Brain Tumour Detection models by experimenting with more expansive datasets and newer and cutting edge image segmentation models along with deep learning algorithms. This research aims to advance patient care, and deepen our understanding of brain tumour dynamics.

1.2 Motivation

Brain Tumors are an extremely dangerous kind of aliment that is quite common in India, brain and nervous system tumors affect about 10 adults out of 100,000. Tumors can also turn malignant and cancerous and cause pressure inside the skull to increase. we choose to work on this problem since we think it is a crucial one that needs immediate attention.

1.3 Objective

Our objective is to improve the accuracy of the existing Brain Tumor Detection Models through the exploration of expansive data sets and cutting-edge image segmentation models, along with focusing on early symptom identification using Machine Learning

2. Literature Survey

Name of paper	Author	Published Year	Methodology Used
Artificial Intelligence Approach for Early Detection of Brain Tumours Using MRI Images	Adham Aleid	March 2023	This research presents a classical automated segmentation method for early-stage brain tumor detection in MRI images, utilizing a harmony search algorithm for multilevel thresholding. Optimized parameters, variance, and entropy functions facilitate histogram partitioning, followed by morphological operations and connected component analysis. Evaluation using Accuracy, Dice Coefficient, and Jaccard index compares favorably to manual assessments and outperforms CNN and DLA methods in terms of speed, complexity, and data management on the BraTS 2017 dataset.
Accurate brain tumour detection using deep convolutional neural network	Md. Saikat Islam Khan	August 2022	This research introduces two deep learning models tailored for identifying brain abnormalities and classifying tumor grades (meningioma, glioma, and pituitary). The "proposed 23-layer CNN" is designed for large image data volumes. A comprehensive data augmentation technique boosts the latter model's performance. Experimental results show both models significantly enhance brain tumor diagnosis prediction, achieving 97.8% and 100% accuracy for dataset 1 and dataset 2, respectively, surpassing previous studies in the literature.

2. Literature Survey

Name of paper	Author	Published Year	Methodology Used
MRI-based brain tumor detection using convolutional deep learning methods and chosen machine learning techniques	Soheila Saeedi	January 2023	This study utilized a dataset of 3264 MRI brain images, applying preprocessing and augmentation. Two pre-trained models, a 2D CNN and a convolutional auto-encoder network, were developed. Training accuracies were 96.47% and 95.63%, with average recall values of 95% and 94%. Machine learning methods were also compared, with K-Nearest Neighbors achieving the highest accuracy (86%). Statistical tests confirmed significant differences between the proposed models and various machine learning methods (p-value < 0.05).
Brain tumor detection from MRI images using deep learning techniques	P Gokila Brindha	2021	This paper employs Artificial Neural Network (ANN) and Convolutional Neural Network (CNN) for classifying normal and tumor brain images. ANN, mimicking the human nervous system, is trained with interconnected layers. CNN, focusing on image input, utilizes operations like convolution and maxpooling. ANN achieves 80.77% testing accuracy, while CNN, known for image analysis, yields 65.21%, suggesting potential improvement with augmented data.

2. Literature Survey

Name of paper	Author	Published Year	Methodology Used
Brain Tumor Diagnosis Using Machine Learning, Convolutional Neural Networks, Capsule Neural Networks and Vision Transformers, Applied to MRI: A Survey	Andronicus A	July 2022	This survey explores brain tumor classification and segmentation techniques, focusing on CNNs, Capsule Neural Networks (CapsNets), and Vision Transformers (ViTs). CNNs, while successful, face challenges with dataset size and affine transformations. CapsNets address CNN limitations, offering resistance to rotations. ViTs handle long-range dependencies efficiently. CapsNets require less data for training and demonstrate potential for improved accuracy in brain tumor diagnosis. ViTs with self-attention mechanisms excel in modeling long-range dependencies for precise segmentation.
Epigenetic MRI: Noninvasive imaging of DNA methylation in the brain	Fan Lam	March 2022	A groundbreaking method, epigenetic MRI (eMRI), is introduced for nondestructive measurement of global gene expression in living brains. Leveraging DNA methylation and 13C-enriched diets, eMRI maps spatial distribution of labeled DNA, revealing regional differences in global DNA methylation. The technique, validated in pig brains, promises transformative insights into human brain function, behavior, and disease.

3. Problem Description

"OMAD – Brain Tumour Detection" deploys advanced ML models for precise brain tumor identification and early symptom detection in MRI/CT scans. Emphasizing validated datasets and collaboration with medical experts, the project exhibits a comprehensive and ethical approach. Its focus on continuous updates and scalability signals potential impact in clinical diagnostics.

3.1 Problem Statement

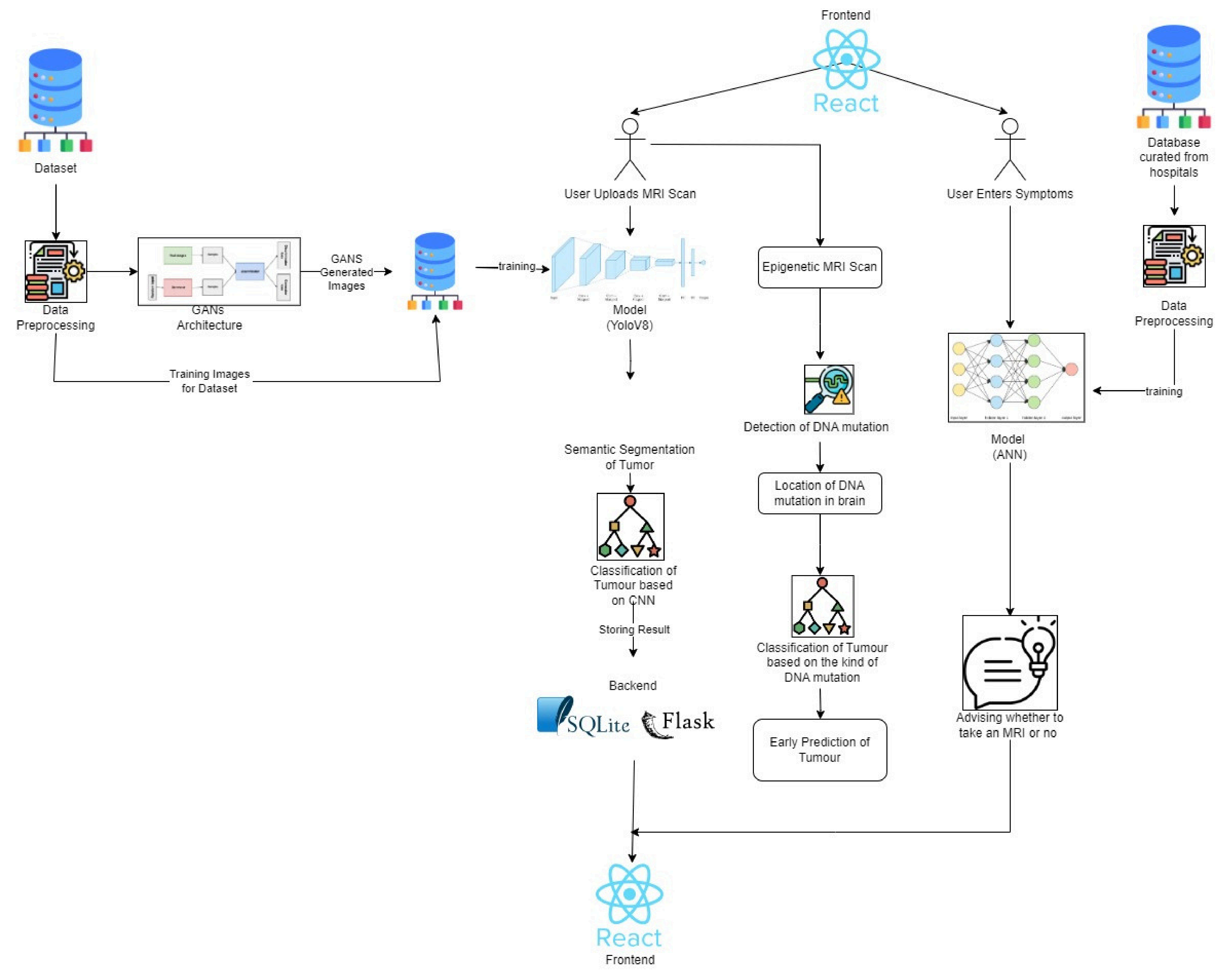
Use Machine Learning and Deep Learning models to detect brain tumours in MRI/CT scan images with improved accuracy and also to identify and detect possible symptoms of brain tumours very early.

3.2 Scope of the Project

Applying the newest unexplored Machine Learning models for semantic segmentation and object detection in images to MRI/CT scan images of brain tumours after training those models with professionally validated expansive datasets of such scans. Also conducting research in the early symptoms of brain tumours and how their detection can be automated.

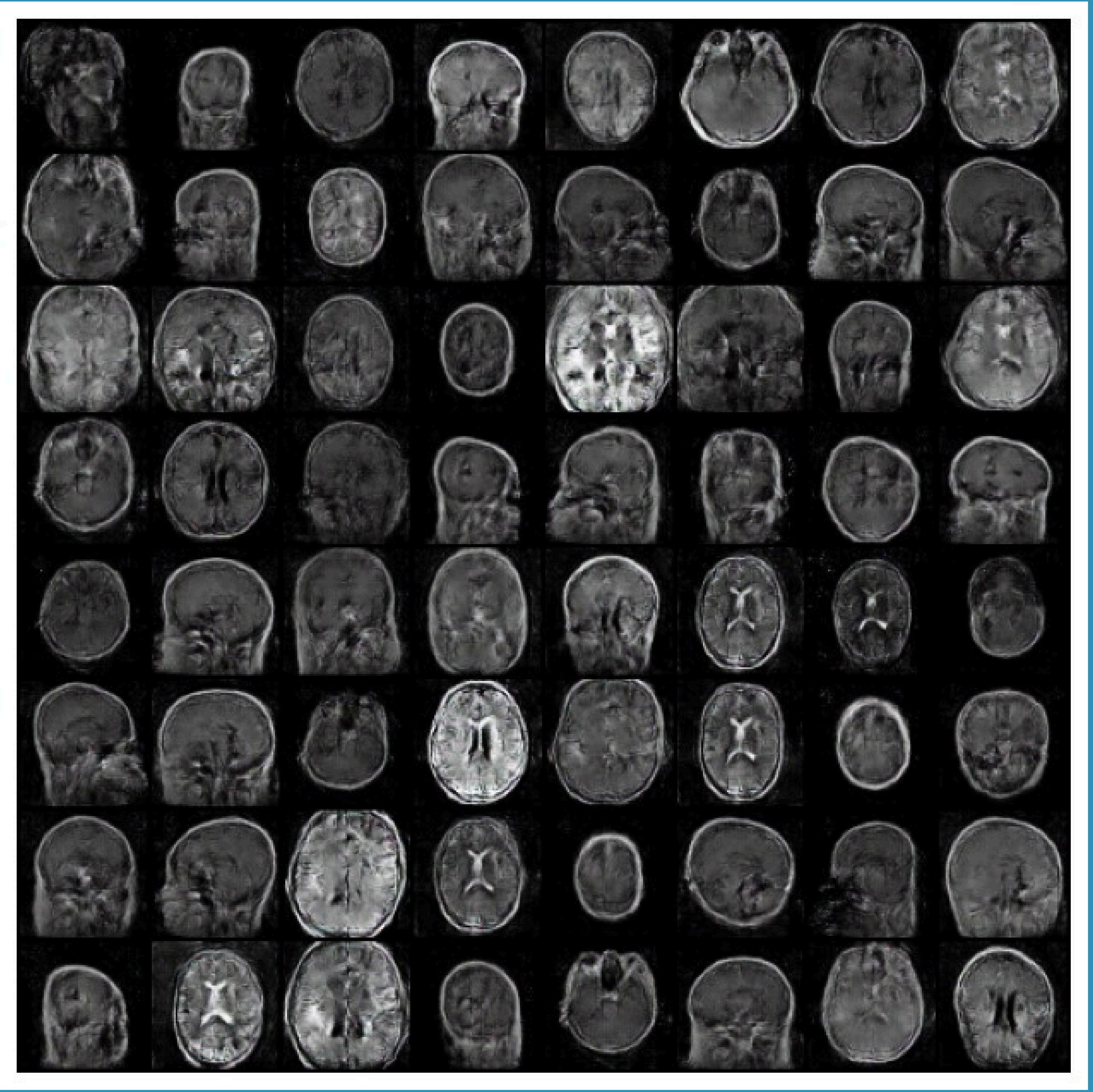
4. Proposed Design

- MRI scan input from the user
- Segmentation by YOLOv8/ViT
- Tumour Classification using CNN model trained on GAN generated dataset
- Provided information regarding effects of each tumour of various body functionalitie
- Stored in database
- Displayed in frontend



4.1 Dataset Generation

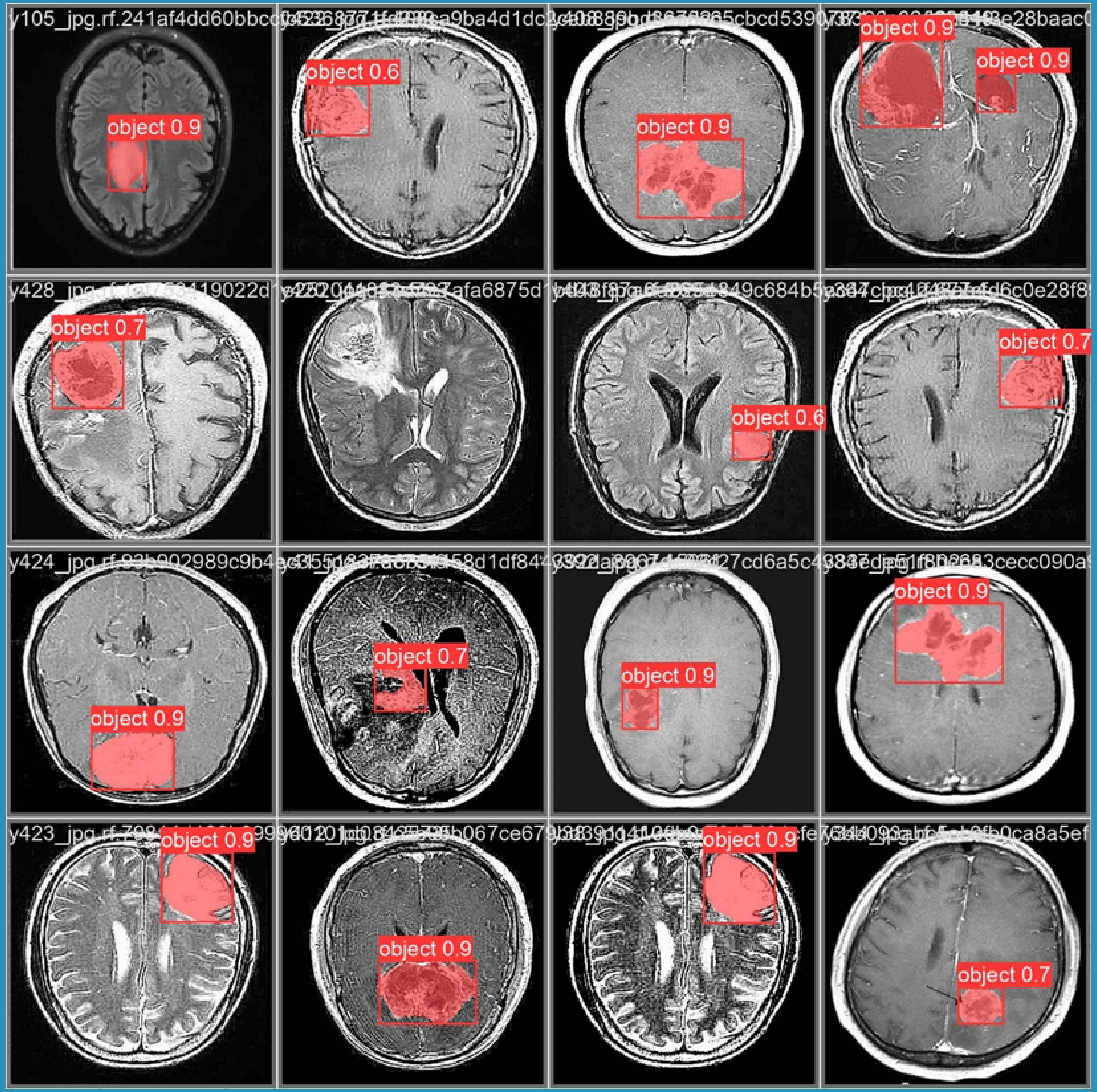
- Our main issue was the lack of sufficient medical datasets
- To solve this issue we decided to use GAN architecture models
- We trained GAN on each class of an existing brain tumour dataset
- GAN artificially generates new brain tumour MRI scans
- We used this GAN generated dataset to train our classification CNN model



5. Results and Discussion

```
YOLOv8n-seg summary (fused): 195 layers, 3258259 parameters, 0 gradients, 12.0 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95)
                   all        100         98      0.866      0.923      0.935      0.796
Speed: 0.4ms preprocess, 6.4ms inference, 0.0ms loss, 7.1ms postprocess per image
```

- 93.5% accuracy with a trained YOLOv8 (CNN) model
- Trained on a dataset of 500 images


y105_jpg.rf.241af4dd60bbc
object 0.9
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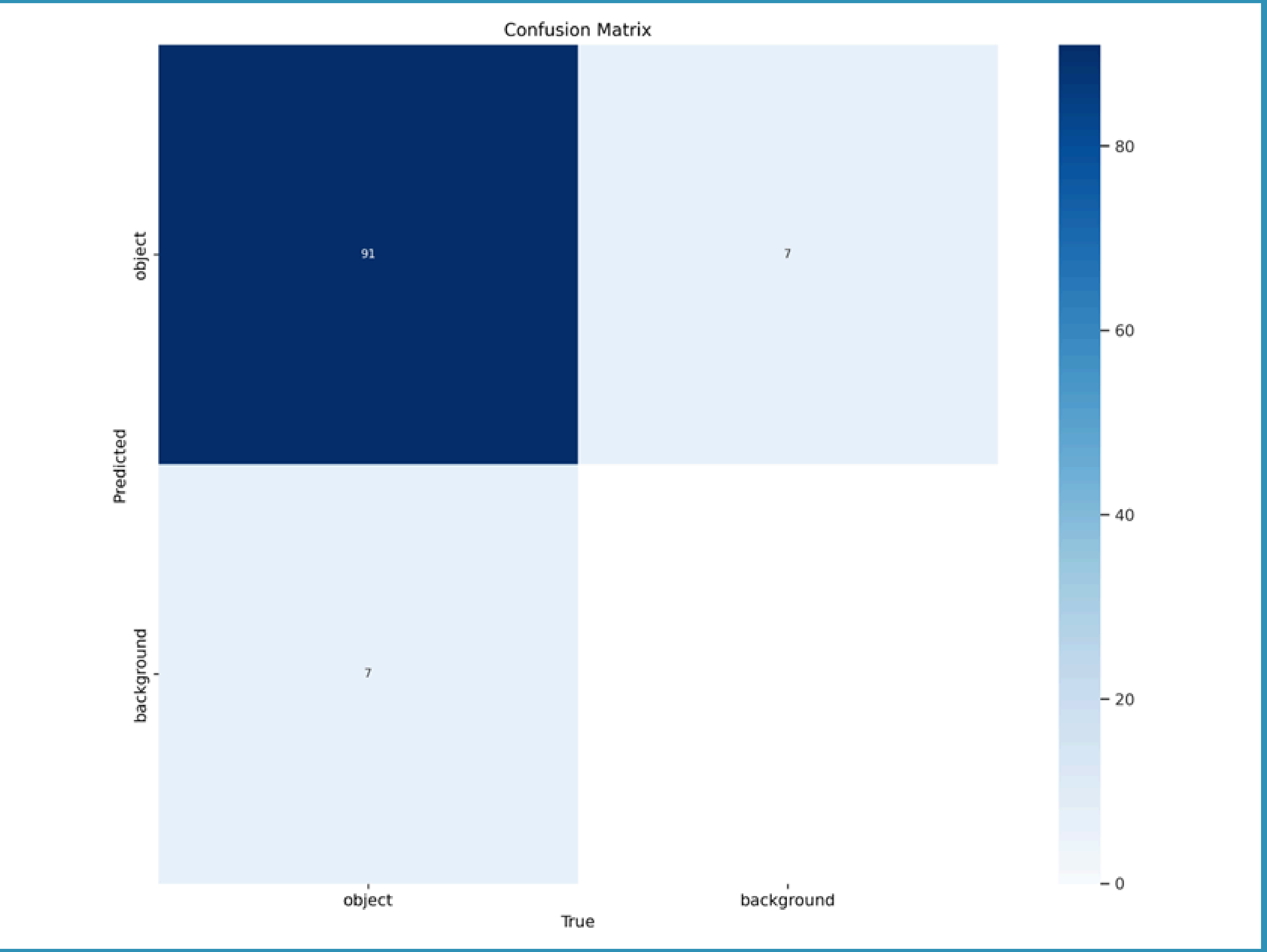
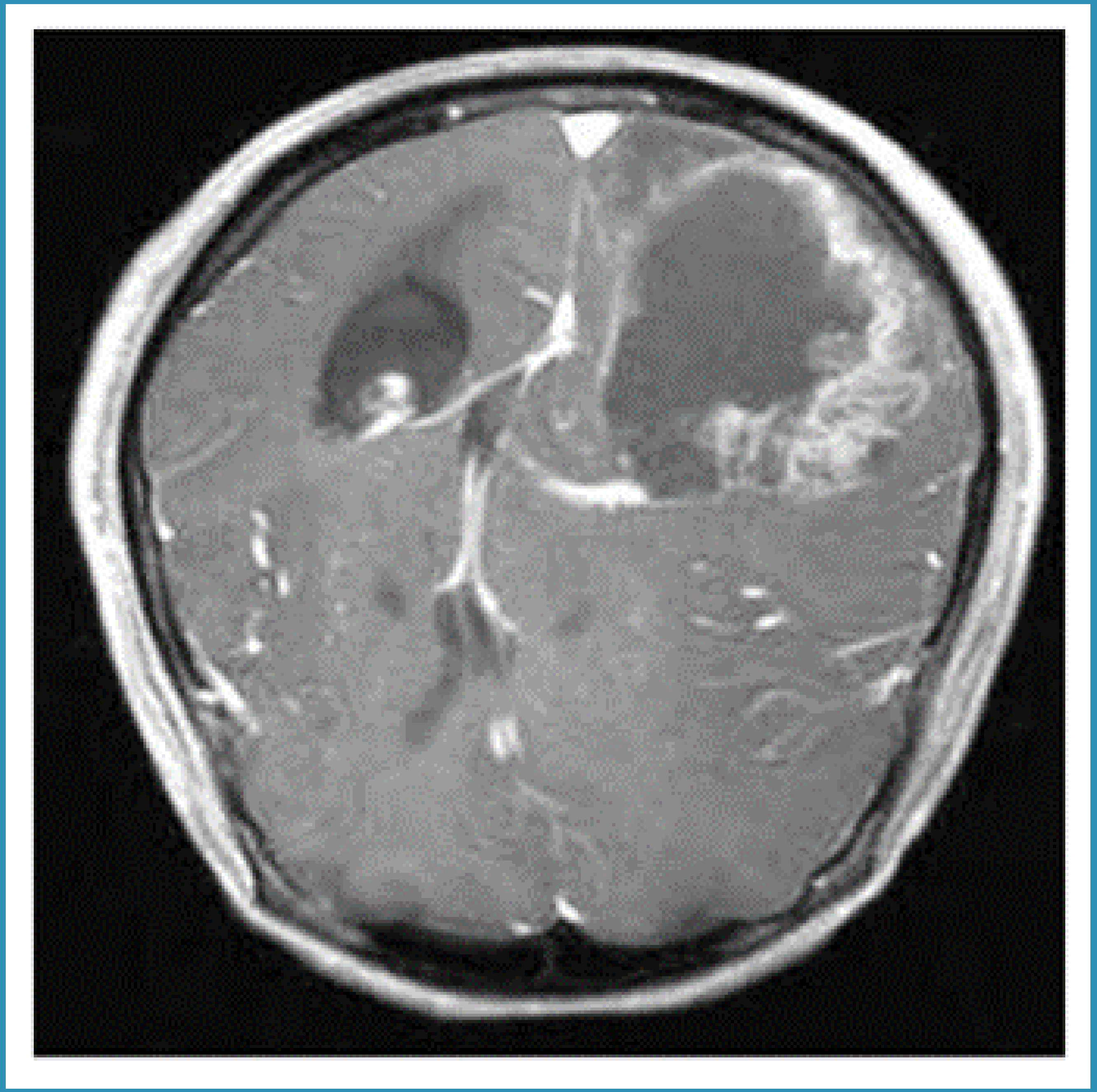
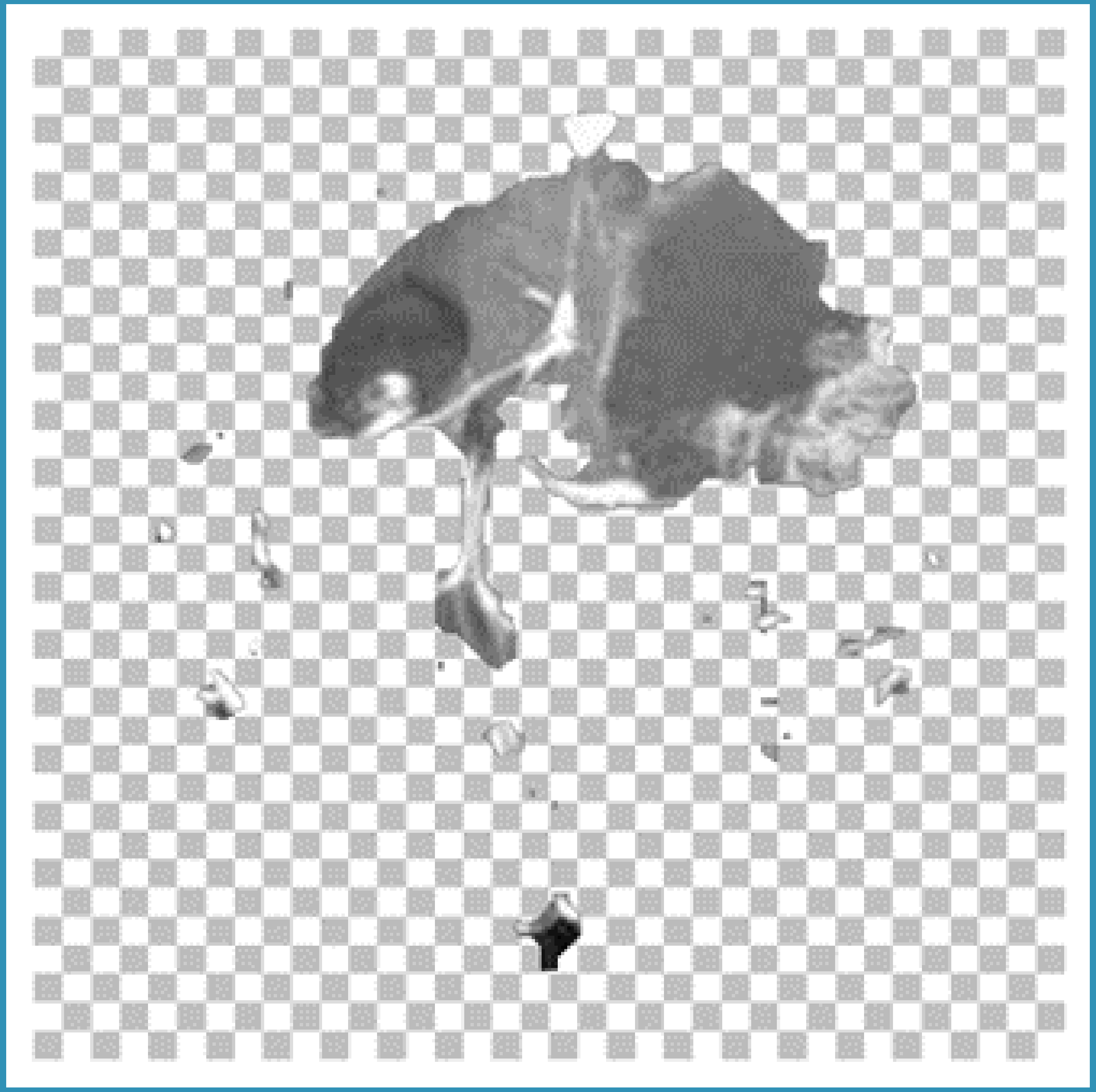

Confusion Matrix
91
7
7
object
background
Predicted
object
background
True
80
60
40
20
0

- Pretrained Dino ViT (Vision Transformer) Segmentation





```
40/40 [==============================] - 5s 121ms/step - loss: 0.0441 - accuracy: 0.9922
Test Loss: 0.04409
Test Accuracy: 0.99219
```

- 99.22% accuracy with a trained Tensorflow CNN model
- Trained on a dataset of 5000 images

Our website running on the YOLOv8 model:

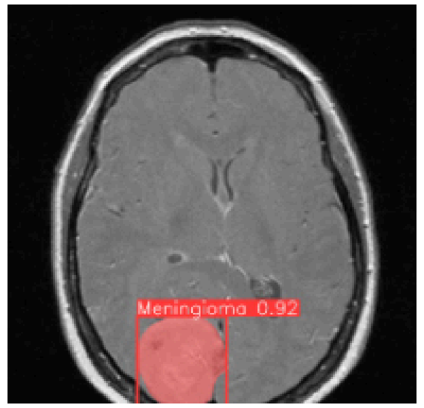
Brain Tumour Detection

Abhay Mathur

Test 4

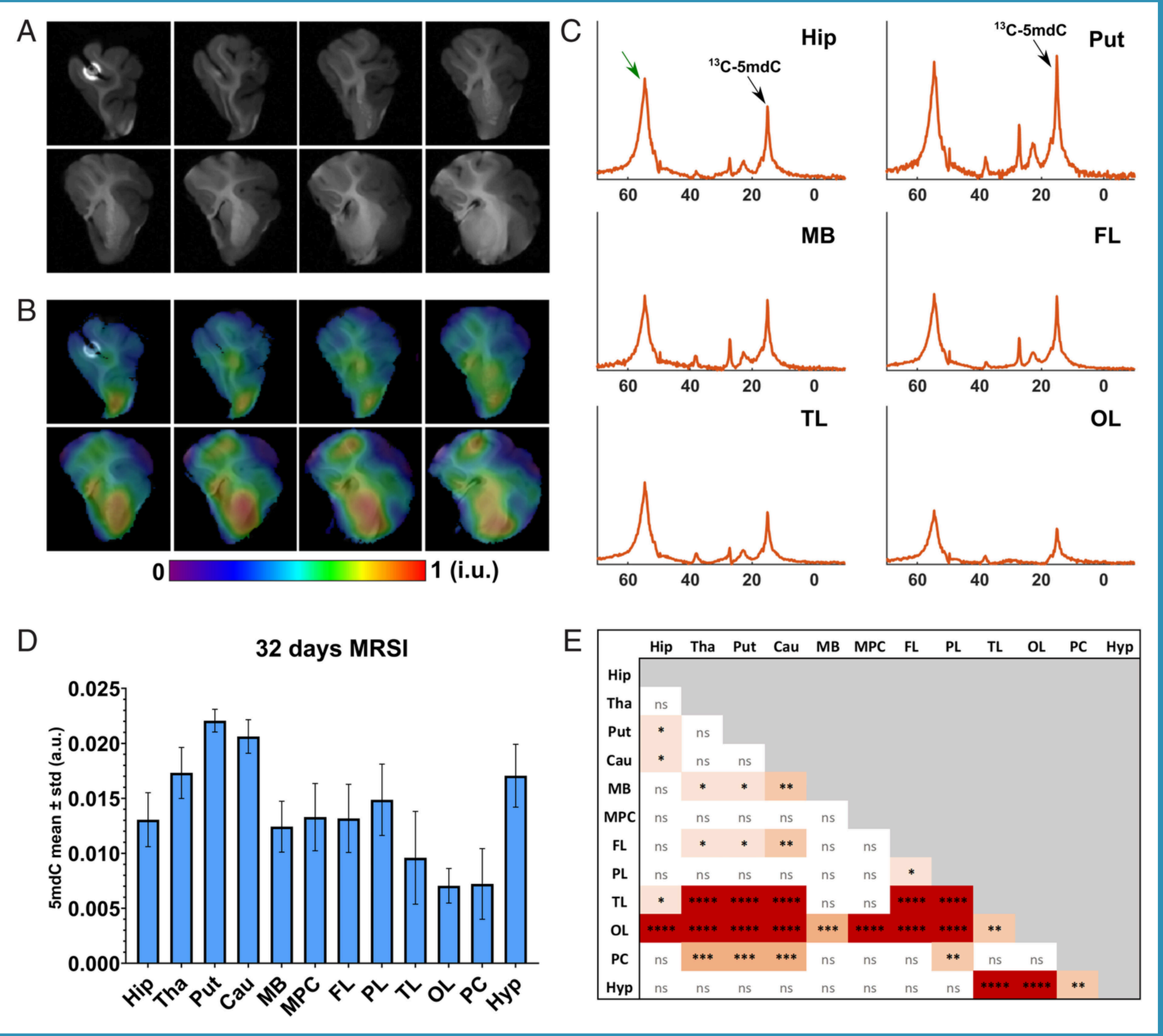
Choose File Te-no_0010.jpg **Upload File**

Patient MRI Scans

#	Filename	Patient Name	Description	Tumour Type	Affected Body Functionality	Segmented Image	Date Uploaded	
1	Te-me_0010.jpg	Darsh Thakkar	Test 1	Meningioma Tumour	Brain, Spinal Cord, Sleep		Thu, 16 May 2024 06:17:07 GMT	Delete

The novelty of our project, eMRI:

We are exploring a cutting-edge technology called eMRI, or **Epigenetic MRI**, to identify **DNA methylation** in the brain, a significant factor linked to the development of brain tumors. This innovation holds the promise of early detection, allowing us to foresee the likelihood of a brain tumor forming. By analyzing DNA changes in brain cells through eMRI scans, we aim to predict the occurrence of tumors in the brain long before they manifest physically. This breakthrough approach could revolutionize our ability to identify potential threats and intervene at an early stage, providing a proactive means of addressing the onset of brain tumors.

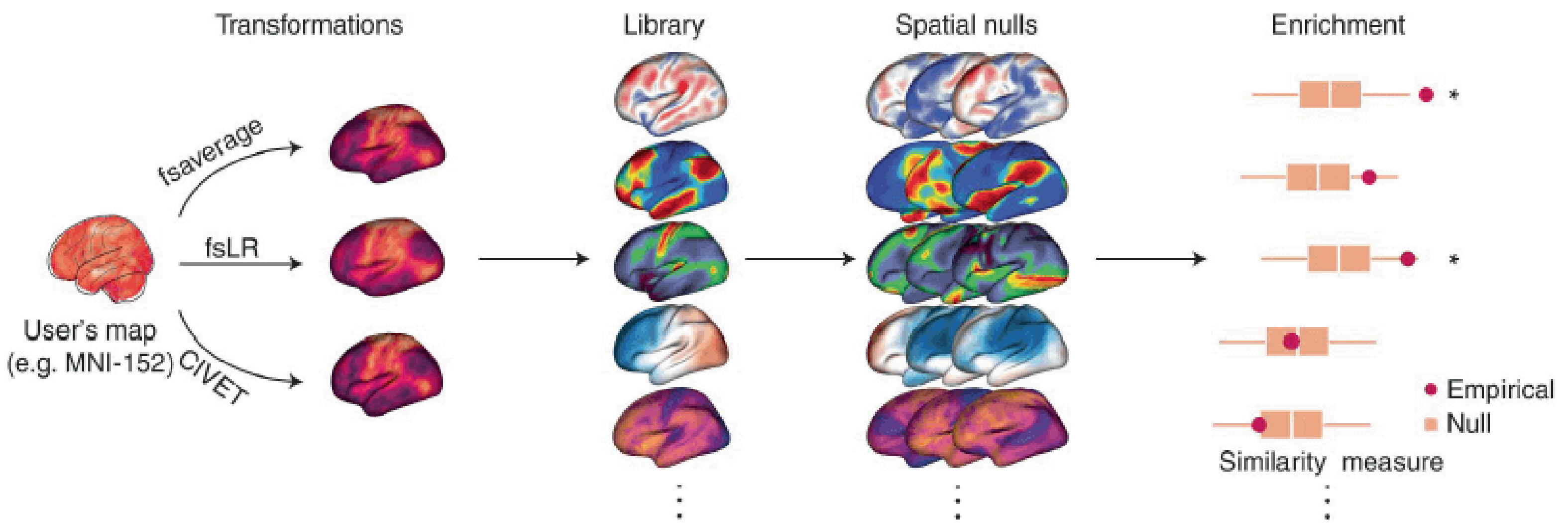


Functional MRI & Neuromapping:

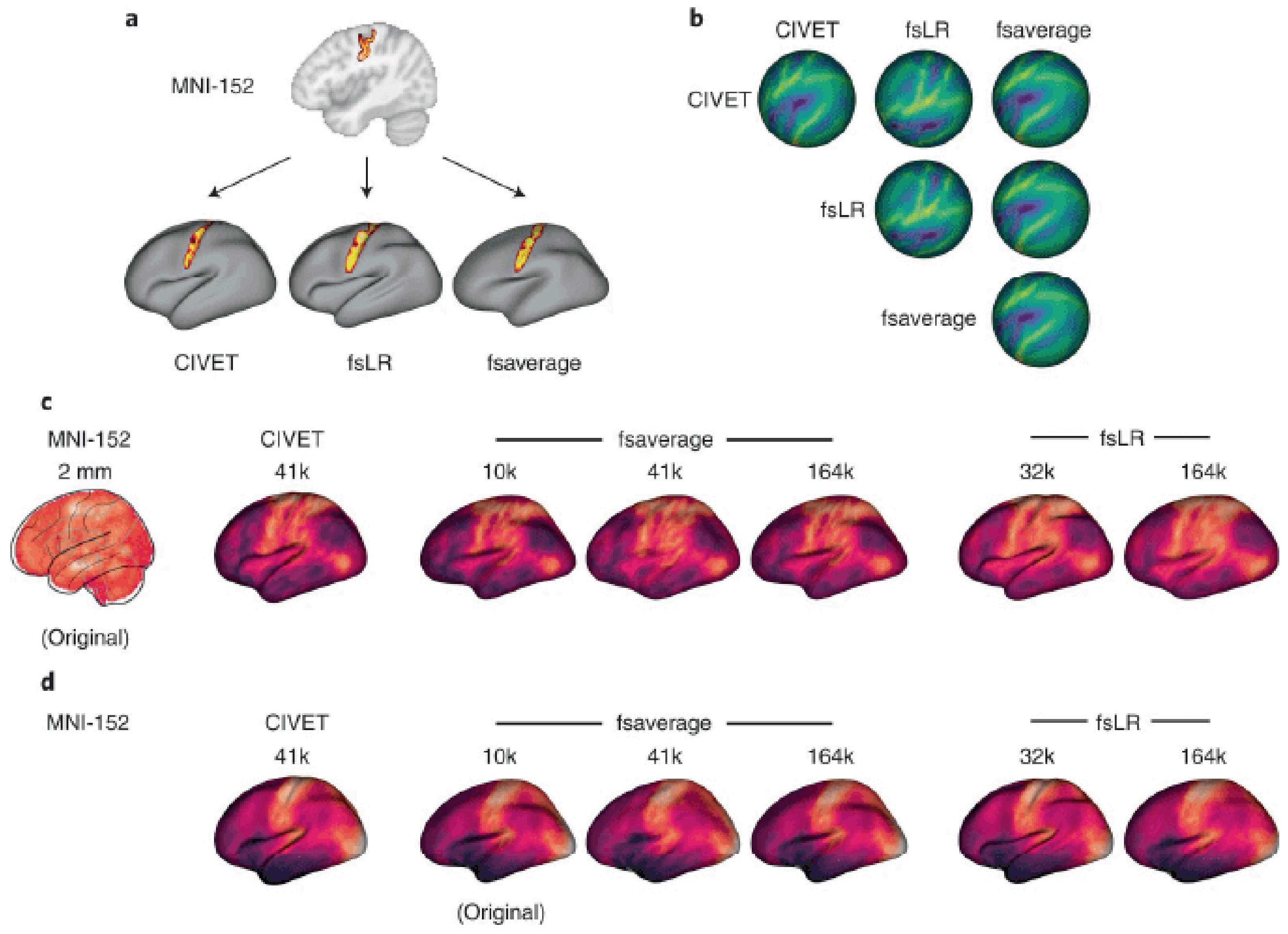
Functional MRI (fMRI): Functional MRI is a non-invasive imaging technique that measures brain activity by detecting changes in blood flow. It relies on the principle that active brain regions require more oxygenated blood, leading to increased blood flow to those areas. By tracking these changes, fMRI can identify which regions of the brain are involved in specific tasks or cognitive processes.

Neuromapping refers to the process of creating detailed maps of the brain's structure and function. It involves various techniques, including fMRI, electroencephalography (EEG), magnetoencephalography (MEG), and invasive methods like intracranial recording. Neuromapping helps researchers identify specific brain regions responsible for different functions and understand how these regions interact with each other. By mapping the brain's neural circuits and connections, neuromapping provides crucial insights into brain development, plasticity, and pathology.

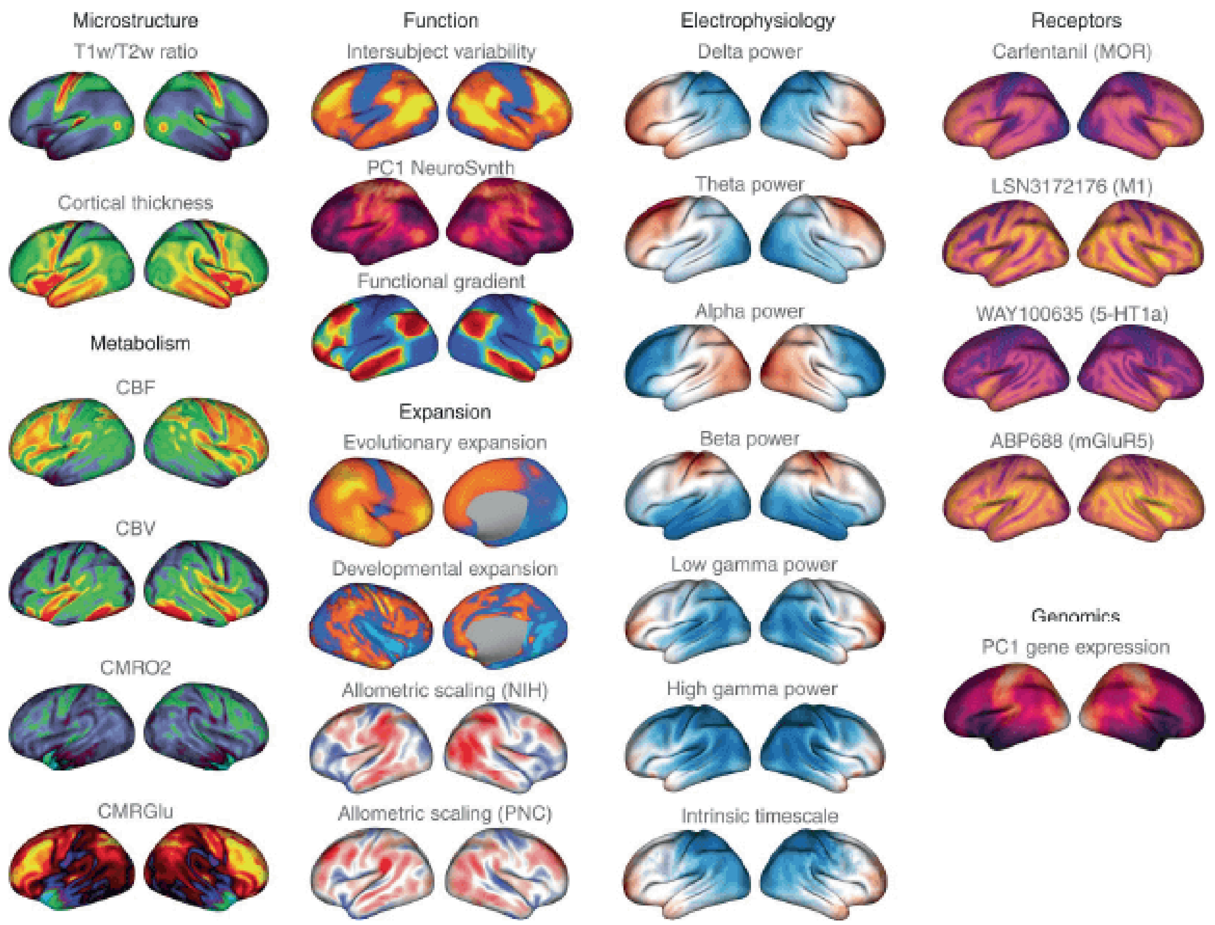
> import neuromaps



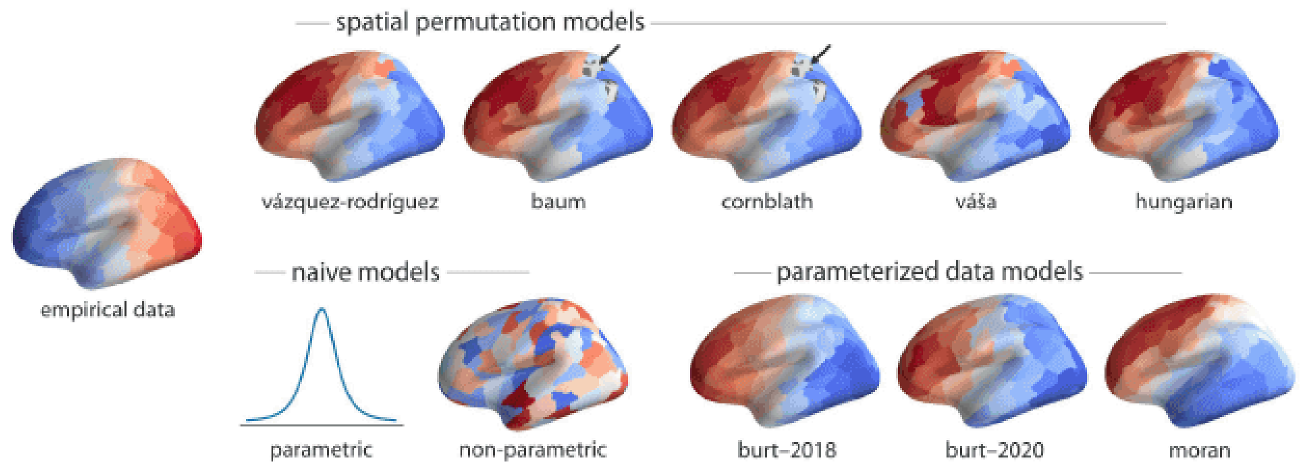
> neuromaps.transforms.<source-space>_to_<target-space>()



> neuromaps.datasets.available_annotations()



> neuromaps.nullls.<spatial-perm-model>()



Markello & Hansen, et al., 2022; Hansen et al., 2022; Markello and Misic, 2021

6. Conclusion

- Medical Diagnostics Advancement:

YOLOv8 in brain tumor detection signifies a significant leap in medical diagnostics.

-Real-time Precision:

YOLOv8's real-time object detection, tailored for medical imaging, showcases impressive accuracy.

- **Effective Tumor Identification:**

The algorithm excels in identifying and precisely locating brain tumors across diverse datasets.

- **Transparency for Professionals:**

YOLOv8's transparency aids healthcare professionals with interpretable results, supporting informed decision-making.

- **Acknowledgment of Challenges:**

While celebrating successes, continuous validation by medical experts and adherence to ethical standards are recognized challenges.

- **Interdisciplinary Collaboration:**

Collaborative efforts between computer scientists and healthcare professionals are essential for refining and responsibly deploying such technologies.

- **Reshaping Medical Diagnostics:**

YOLOv8's success underscores the potential of advanced computer vision in reshaping medical diagnostics.

- **Promise for Improved Outcomes:**

-These advancements hold promise for enhanced patient outcomes and advancements in diagnostic radiology.

7. References

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