DETECTING TUMORS FROM IMAGING

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PROBLEM STATEMENT

DETECTING TUMORS FROM IMAGING

- Detecting tumors based on medical imaging is a significant challenge in the field of healthcare.
- **Imaging techniques** play a vital role in identifying and localizing tumors, providing valuable insights of their presence, location, size, and characteristics in various parts of the body.
- Interpreting medical images to detect tumors is a complex task that requires **expertise**, can be **time-consuming** and prone to **human error**.
- Integrating medical imaging technologies, machine learning algorithms, and clinical expertise are crucial to improve the accuracy and efficiency of tumor diagnosis, classification, and treatment.

ABSTRACT

- Develop a user-friendly interface integrating medical imaging technologies, machine learning, and deep learning for simplified upload of **MRI scans** and generation of detailed analysis reports.
- These images will undergo **instance segmentation, image classification** to accurately detect tumors and classify them.
- Our system will be capable of identifying tumors in various parts of the body, including the **brain, liver, breast, and skin**. It will also segment the exact region of the tumor, distinguishing it from normal tissues. Additionally, the system will classify the type of tumor as either **benign or malignant or no tumor**, providing crucial information for medical professionals.
- The system will then generate a comprehensive **report** based on the analysis, providing valuable insights and aiding in the diagnosis and treatment planning process.
- **Compare our model** with other algorithms and show improved accuracy.
- Create a **digital twin of the brain** which will help to monitor the condition of brain in virtual environment and can predict the result of the treatment in prior

METHODOLOGY & JUSTIFICATION

1

Instance Segmentation : Algorithm is U-Net

- UNet's **U-shaped architecture** captures both local and global context information effectively. It combines low-level and high-level features through a contracting path (encoder) and a symmetric expanding path (decoder) for accurate tumor segmentation.
- **Pixel level segmentation**, Fewer parameters and fast inference.
- this model is used to detect the tumor and segment the tumor
- Comparison of U net with Yolo v8 instance segmentation model

2

Image Classification: Algorithm is ViT (Visual Transformer)

- The Visual Transformer incorporates a **self-attention mechanism** which helps the model understand the important features and patterns within the image, allowing for more accurate tumor classification.
- **parallelization** , the Visual Transformer captures global contextual information by attending to the entire image simultaneously
- This model is used to classify which type of tumor it is.
- Comparison with CNN

3

Report generation

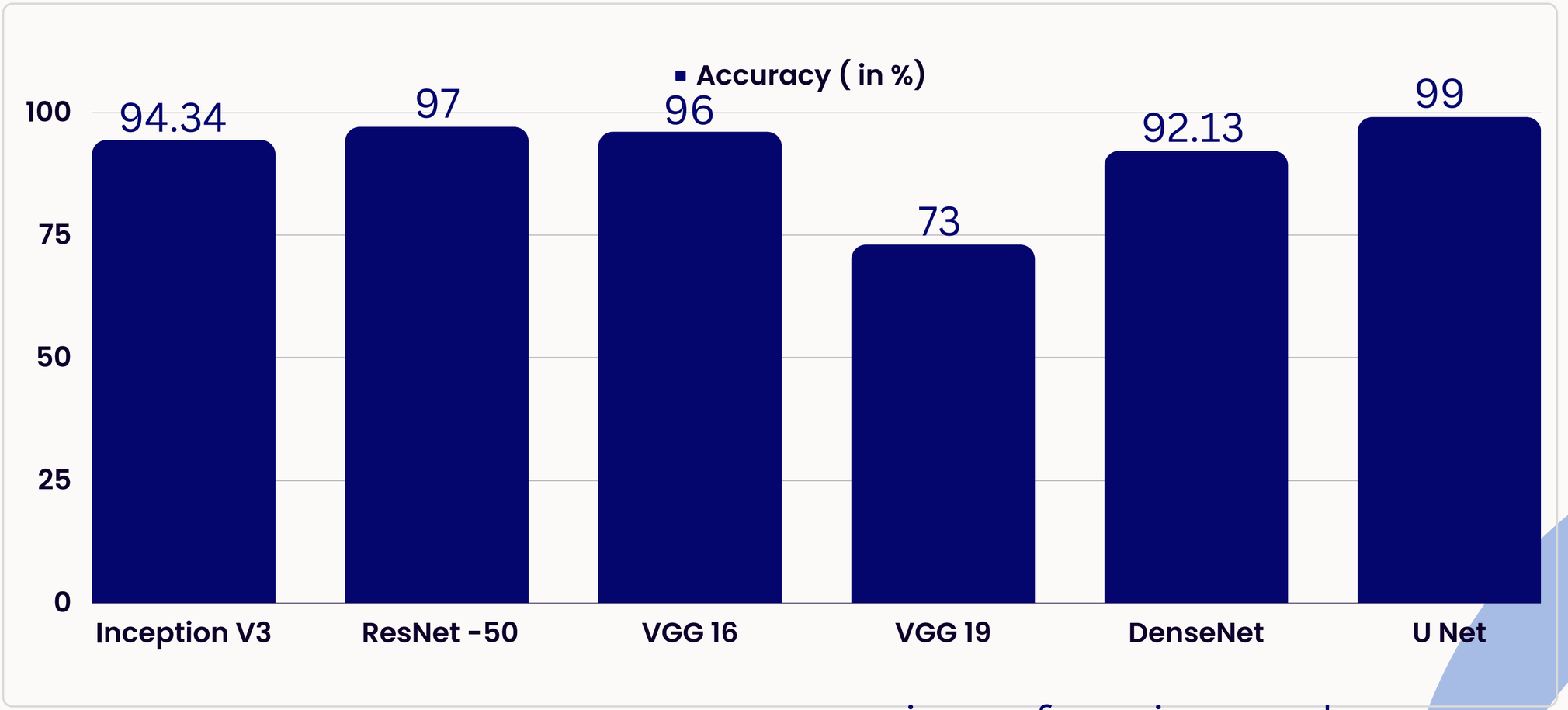
- The comprehensive report generated by the system provides users with a downloadable resource that can be utilized for further treatment processes, as it presents the overall results of tumor classification, aiding in informed decision-making and facilitating the development of personalized treatment plans.

4

Digital Twin

- Development of a digital twin of the brain, which serves as a **virtual replica of an individual's brain** using 3D modelling
- Additionally, it utilizes predictive analytics to forecast the potential outcomes of different treatment approaches. This innovative approach has the potential to revolutionize personalized medicine, allowing for more accurate diagnosis, tailored treatment plans, and improved patient outcomes.

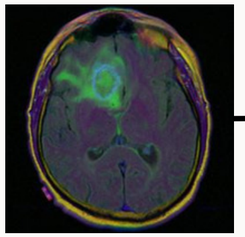
ACCURACY



accuracy comparison of previous works
on brain tumor image segmentation dataset

ARCHITECTURE DIAGRAM

segmentation



input

Pre trained U-Net model

output mask

UI

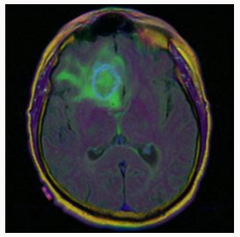
user

uploads

returns

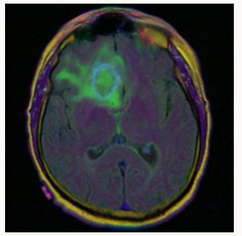
MRI scan

classification



input

fine tune classification by visual Trasformer



type: glioma

downloaded by user

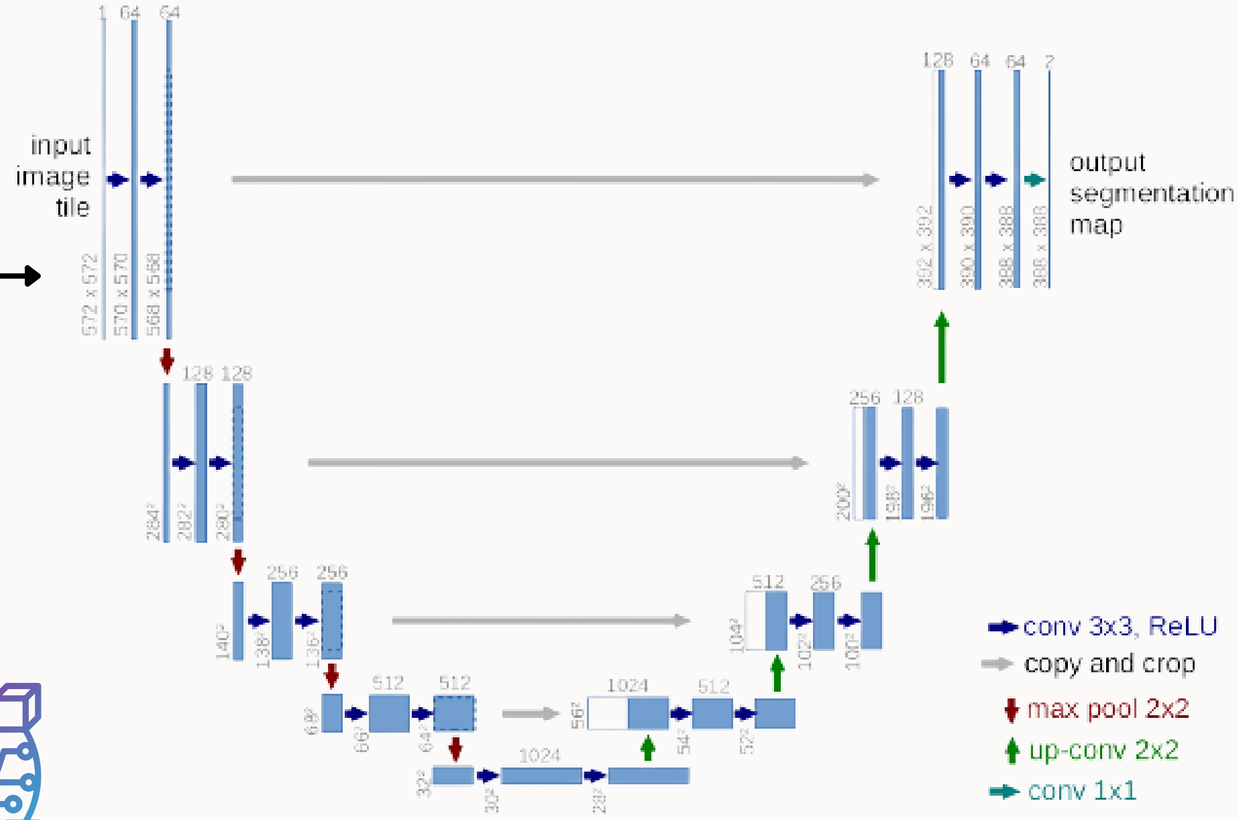
Report generated based on results and rule-based algorithm

IMAGE SEGMENTATION

Amazon Sagemaker

MRI scan images with their ground truth masks

training image



U Net

amazon s3 bucket

ground truth mask

comparison algorithm and model evaluation

preprocessing and augmentation

BraTS Dataset

- Accuracy
- Jaccard distance
- AUC and ROC

(Area under curve and receiver operating characteristic)

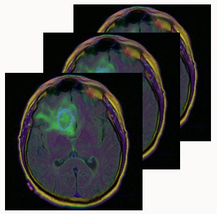
prediction

segmentation mask

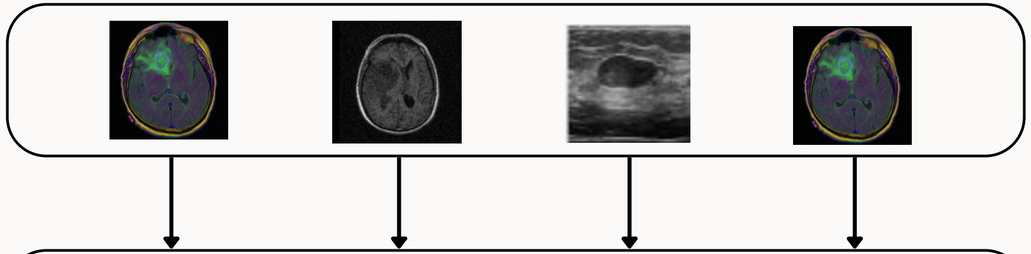
IMAGE CLASSIFICATION

Amazon Sagemaker

training image



Generate
image patches



linear Projection and Position Embedding

amazon s3 bucket

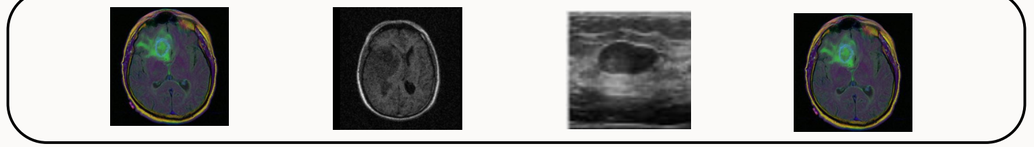
preprocessed
dataset

Transformer blocks

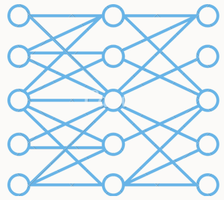
Transformer block

Feed forward neural network (FFNN)

Multi-Head self-Attention



patch embeddings



FFNN

Classification
&
Model
evaluation

- F1 Score
- Sensitivity
- Specificity
- precision
- Accuracy

ETL PIPELINE (EXTRACT TRANSFORM LOAD)

Source 1

Source 2

Source 3

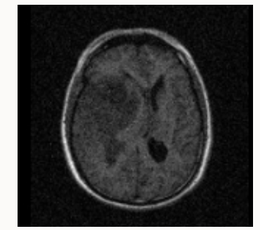
Extract

image preprocessing and augmentation

flip image

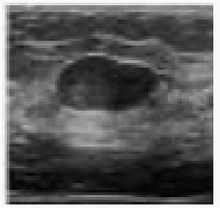
Resize image

gray scale



Remove noise

including null images



blur

Normalization

Transform

load the images into the required format

(.tiff)text image file format

use for training and analysis

DATA ENGINEERING PROCESS

6597 MRI scan images

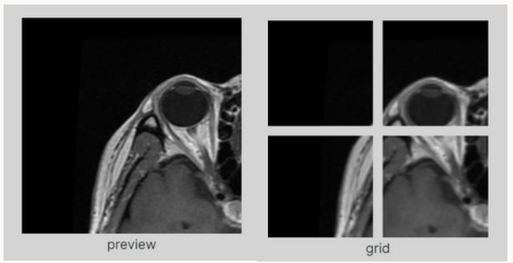
training set
4k images

Validation set
1.9k images

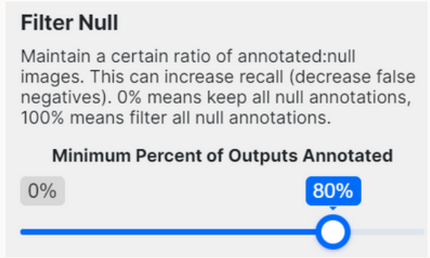
testing set
630 images

roboflow

Resizing
(224 * 224)



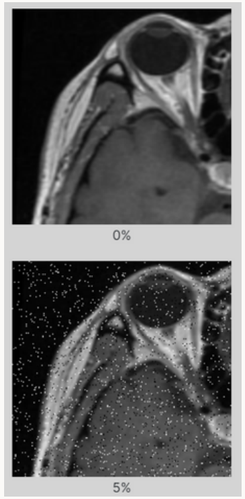
tile (2 rows* 2 columns)



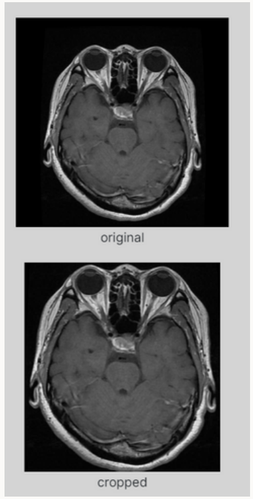
filter null to 80 %

Preprocessing

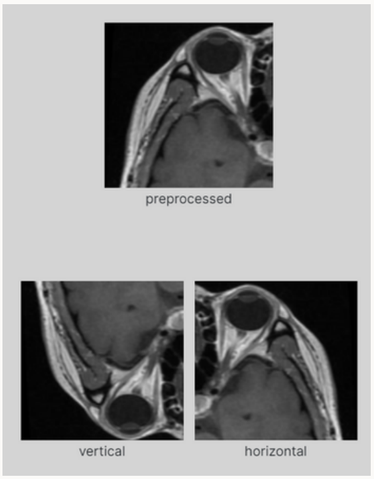
Generated a new version with 13k images



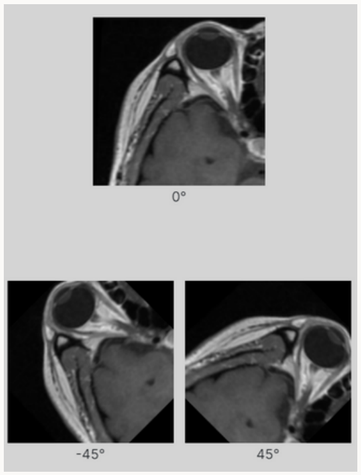
included 5 % noise



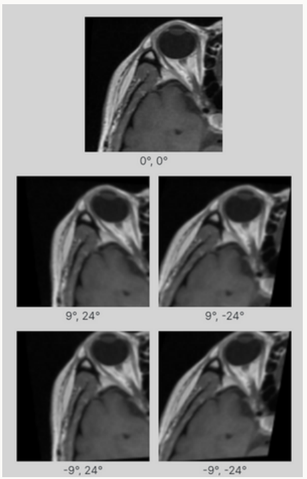
Static crop



flip
horizontal and vertical



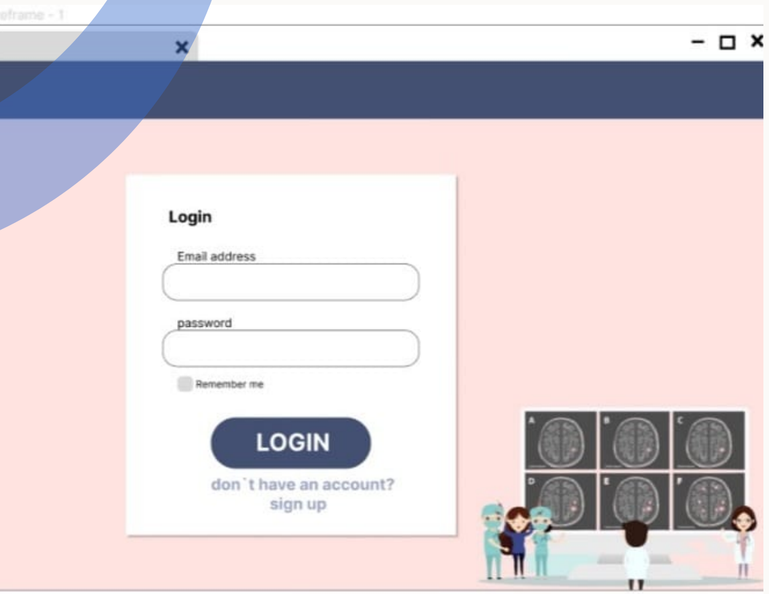
Rotate
45 deg to right and left

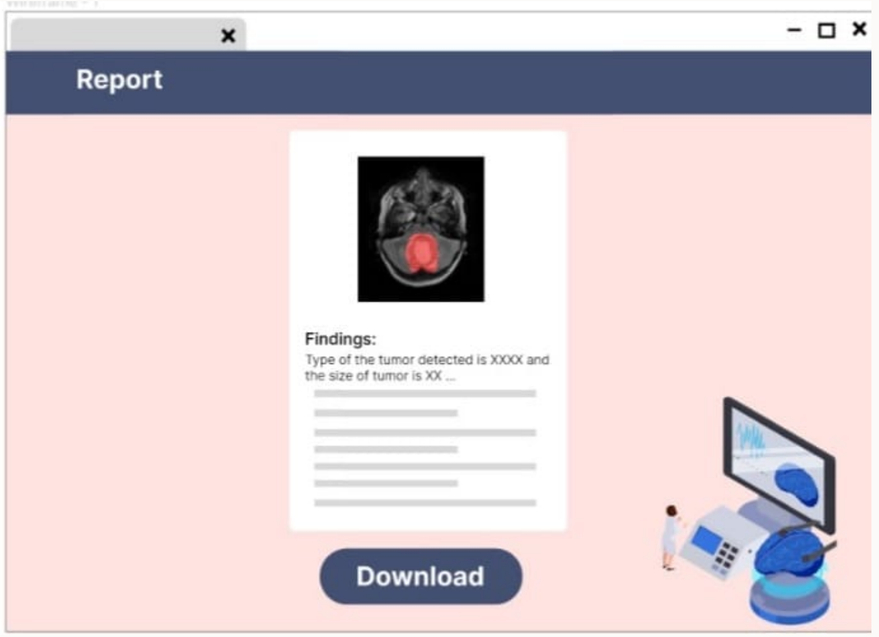


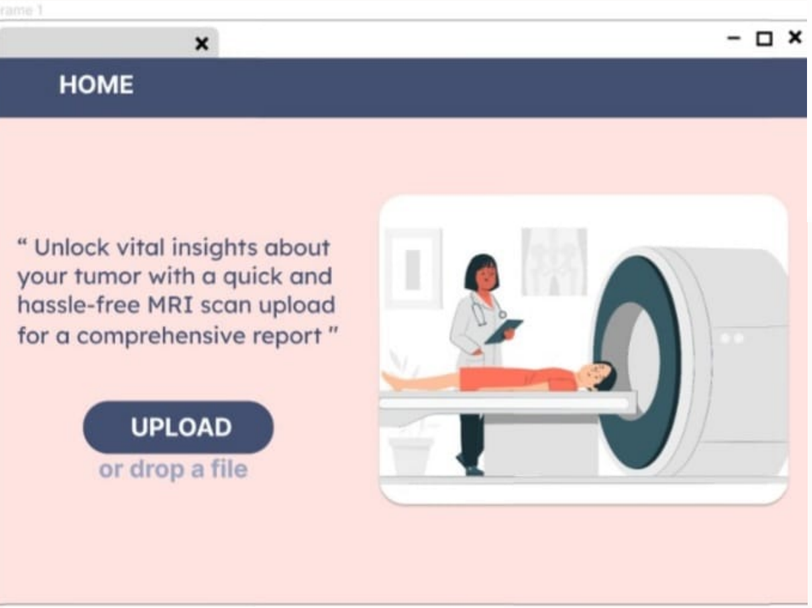
shear
horizontal: 9 deg
vertical: 24deg

Augmentations

USER INTERFACE







Patient: Snehita raju
DOB:01/05/2002
Gender&Age: Female (21)
Date:11/7/23
Region : Brain
Technique: MRI scan imaging
Findings:
A tumor has been detected of size 0.38mm sq. .The type of tumor is glioma.
Impression:
The glioma tumors can be malicious. So consult the doctor as soon as possible

REFERENCES

1. Andr´es Anaya-Isaza, Leonel Mera-Jimenez *, Lucía Verdugo-Alejo, Luis Sarasti, Optimizing MRI-based brain tumor classification and detection using AI: A comparative analysis of neural networks, transfer learning, data augmentation, and the cross-transformer network, European Journal of Radiology Open,2023
2. Taher M. Ghazal,1,2Sajid Hussain,3Muhammad Farhan Khan,4Muhammad Adnan Khan,3,5Raed A. T. Said,6and Munir Ahmad, Detection of Benign and Malignant Tumors in Skin Empowered with Transfer Learning, Computational Intelligence and Neuroscience,2022
3. 1 Samah A. Gamel,1 El-Sayed M. El-Kenawy,2,* Amal H. Alharbi,3 Doaa Sami Khafaga,3,* Abdelhameed Ibrahim, Brain Tumor Detection and Classification Using Deep Learning and Sine-Cosine Fitness Grey Wolf Optimization, Bioengineering (Basel).2022
4. Adel S. Assiri,1 Saima Nazir,2 and Sergio A. Velastin, Breast Tumor Classification Using an Ensemble Machine Learning Method, J Imaging. 2020
5. Kashfia Sailunaz, Deniz Bestepe, Sleiman Alhajj, Tansel Özyer, Jon Rokne, Reda Alhajj, Brain tumor detection and segmentation: Interactive framework with a visual interface and feedback facility for dynamically improved accuracy and trust, journal. pone.0284418,2023
6. Abdul Hannan Khan,1,2Sagheer Abbas,1Muhammad Adnan Khan,3,4Umer Farooq,5Wasim Ahmad Khan,1Shahan Yamin Siddiqui,1,2and Aiesha Ahmad, Intelligent Model for Brain Tumor Identification Using Deep Learning, Applied Computational Intelligence and Soft Computing,2021
7. Eliott Simon*, A. Briassouli, Vision Transformers for Brain Tumor Classification, Advanced Computing Sciences,2022
8. Mohammad Monirujjaman Khan,1Tahia Tazin,1Mohammad Zunaid Hussain,1Monira Mostakim,1Taeefur Rehman,1Samender Singh,2Vaishali Gupta,3and Othman Alomeir, Breast Tumor Detection Using Robust and Efficient Machine Learning and Convolutional Neural Network Approaches, Computational Intelligence and Neuroscience,2022.
9. **Liqun Huang[1†], Enjun Zhu[2†], Long Chen[1], Zhaoyang Wang[1], Senchun Chai[1*] and Baihai Zhang, A transformer-based generative adversarial network for brain tumor segmentation, Front. Neurosci., 30 November 2022**

THANK YOU