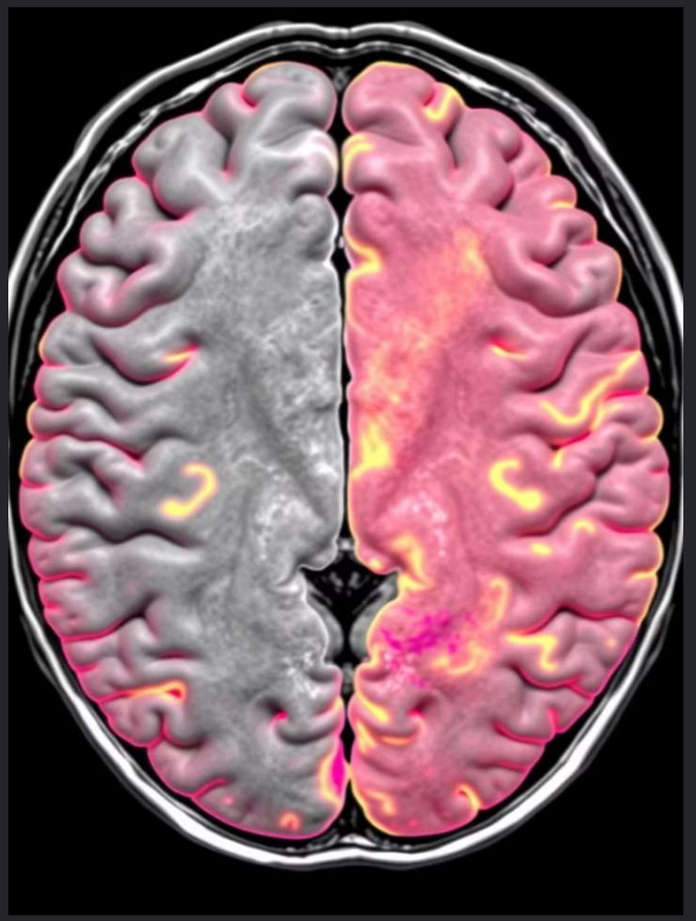
Brain Tumor Segmentation Using Deep Learning (U-Net Architecture)



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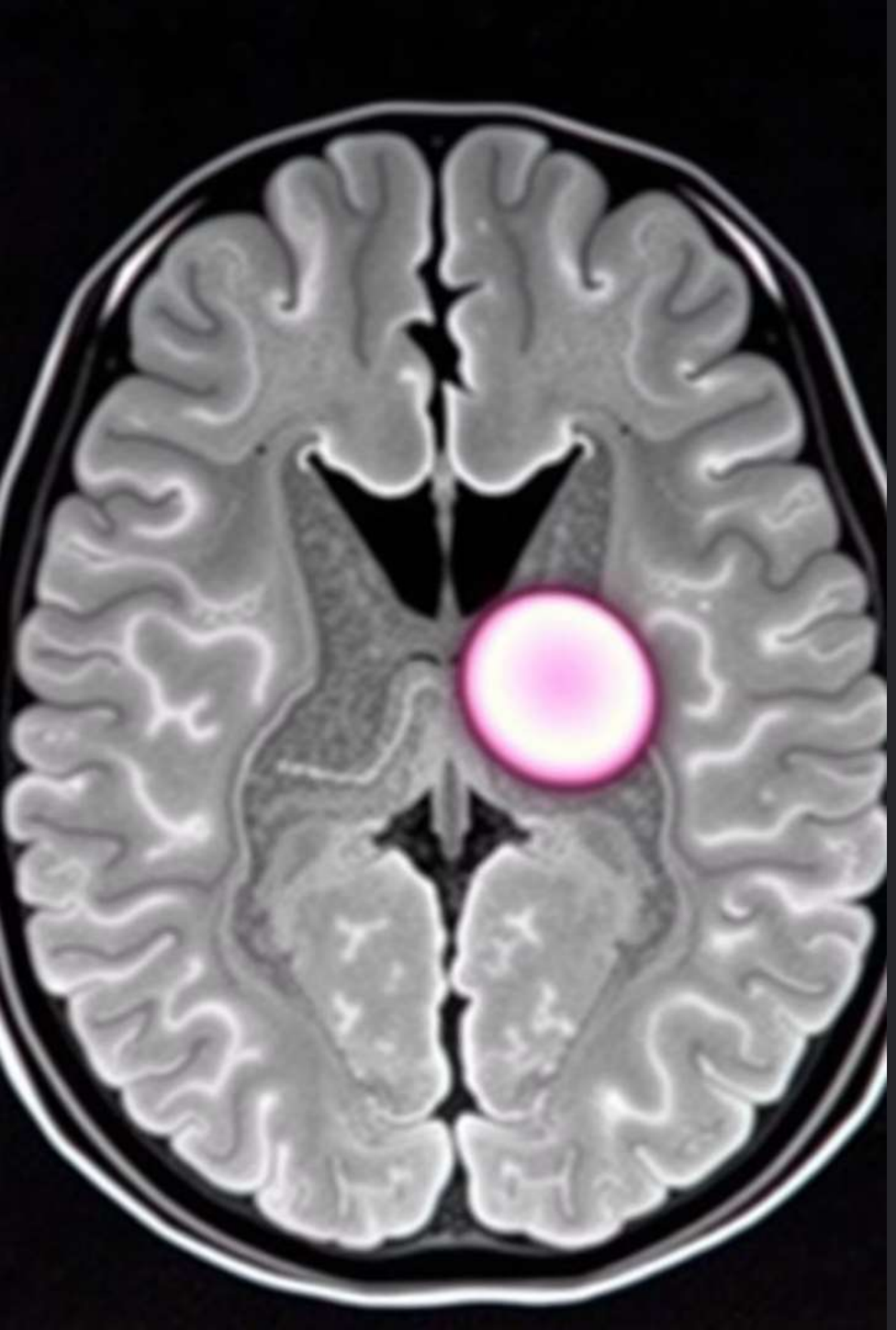


Brain Tumor Segmentation Using Deep Learning (U-Net)

Leveraging U-Net architecture for precise tumor delineation.

Improving diagnostic accuracy and treatment planning.

Deep learning applications in medical imaging: a concise overview.

Objective: Accurate Brain Tumor Segmentation

Automation Goal

Enhance tumor segmentation from MRI scans automatically.

Model Used

Use U-Net model for precise pixel-level tumor identification.

Clinical Impact

Reduce human error and time required for manual segmentation.

Problem Domain: Challenges in Medical Imaging

High Variability

Tumor size, shape, and location vary widely across patients.

Data Limitations

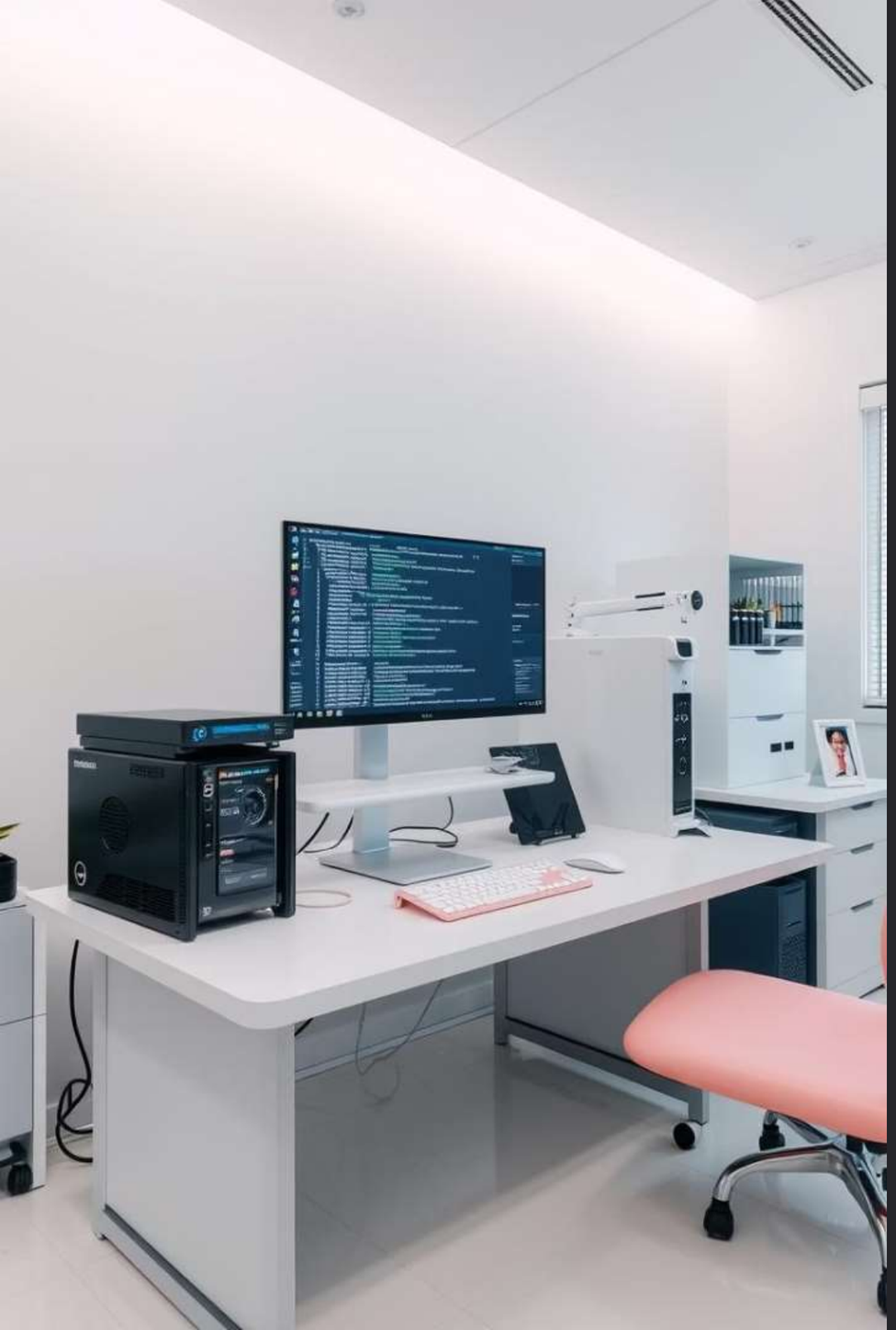
Few annotated medical images available for training deep models.

Need for Precision

Good accuracy required for clinical-grade segmentation.

Example

Gliomas often have irregular, fuzzy tumor boundaries.



Tools & Libraries Used

- **Data Handling:** numpy, pandas
- **Visualization:** matplotlib, seaborn
- **Image Processing:** OpenCV, scikit-image
- **Machine Learning:** scikit-learn
- **Deep Learning:** TensorFlow, Keras

Dataset Description:

- Source: Kaggle - LGG MRI Segmentation
- MRI scans and corresponding masks.
- Dataset split:
  - Training: 80%
  - Validation: 10%
  - Testing: 10%

U-Net Architecture for Segmentation

1

Encoder Path

Downsamples input, captures context features

2

Decoder Path

Upsamples and recovers spatial details

3

Skip Connections

Preserve fine details by concatenating features

4

Modifications

Residual blocks and attention gates for accuracy

Training the U-Net Model

1 **Loss Functions**

Binary Cross entropy

2 **Optimizer**

Adam

3 **Techniques**

Batch Normalization, and Data Augmentation

4 **Training**

120 epochs, batch size 40

Evaluation Metrics

ACCURACY:
Correct pixel prediction rate.

IoU (Intersection over Union):

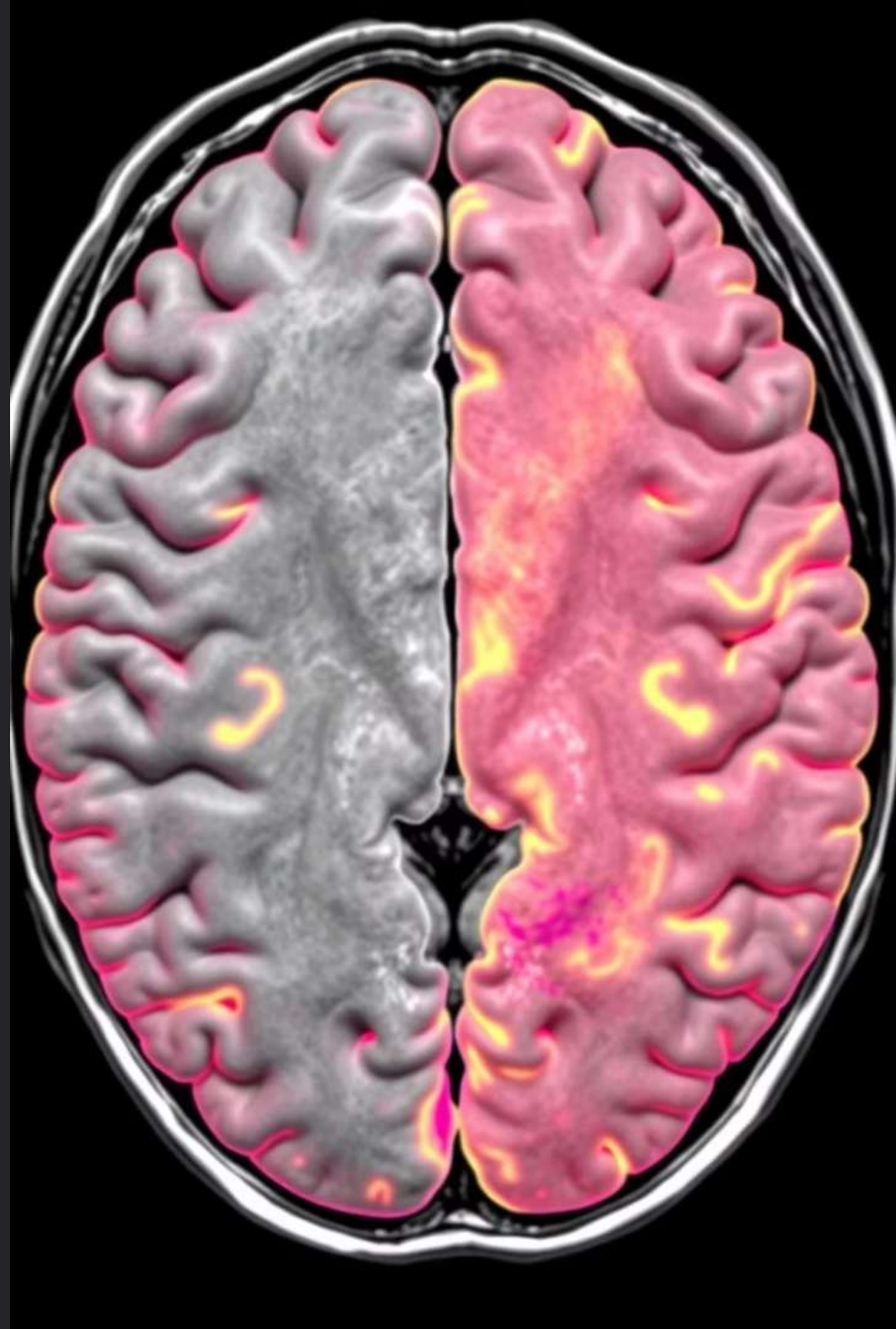
Overlap of predicted and true mask.

Dice Coefficient:
2 x (Intersection) / (Predicted + Actual)

Result Visualization and Analysis

Compare:

- Original MRI Image
- Ground Truth Mask
- Predicted Mask



Conclusion:

- U-Net is effective for brain tumor segmentation.
- Provides high accuracy in identifying tumor structures.
- Supports medical imaging workflow with automation.