

Hybrid Xception-ViT for Automatic White Matter Lesion Diagnosis with Explainable AI

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Motivation and Problem

White Matter Lesions (WMLs) [1] are regions of abnormal tissue in the brain's white matter. These lesions can cause neurological issues such as cognitive issues, vision problems, balance difficulties. Early diagnose of WML is crucial.

Dataset & Methodology Pipeline

Source: Cyril and Methodius Hospital.

Size: 559 MRI scans (382 positives and 177 negative) in DICOM format.

Solution or Contributions

ML and DL models detect WMLs well but struggle with small lesions and lack explainability. **Our contributions are :**

1. Expand dataset to solve the imbalance issue.
2. Detecting small WMLs is challenging; we propose a hybrid Xception-ViT with a modified Vision Transformer [2] for accurate detection.
3. Apply deep learning algorithms for WML diagnosis from MRI using XAI methods to ensure transparency and trust.

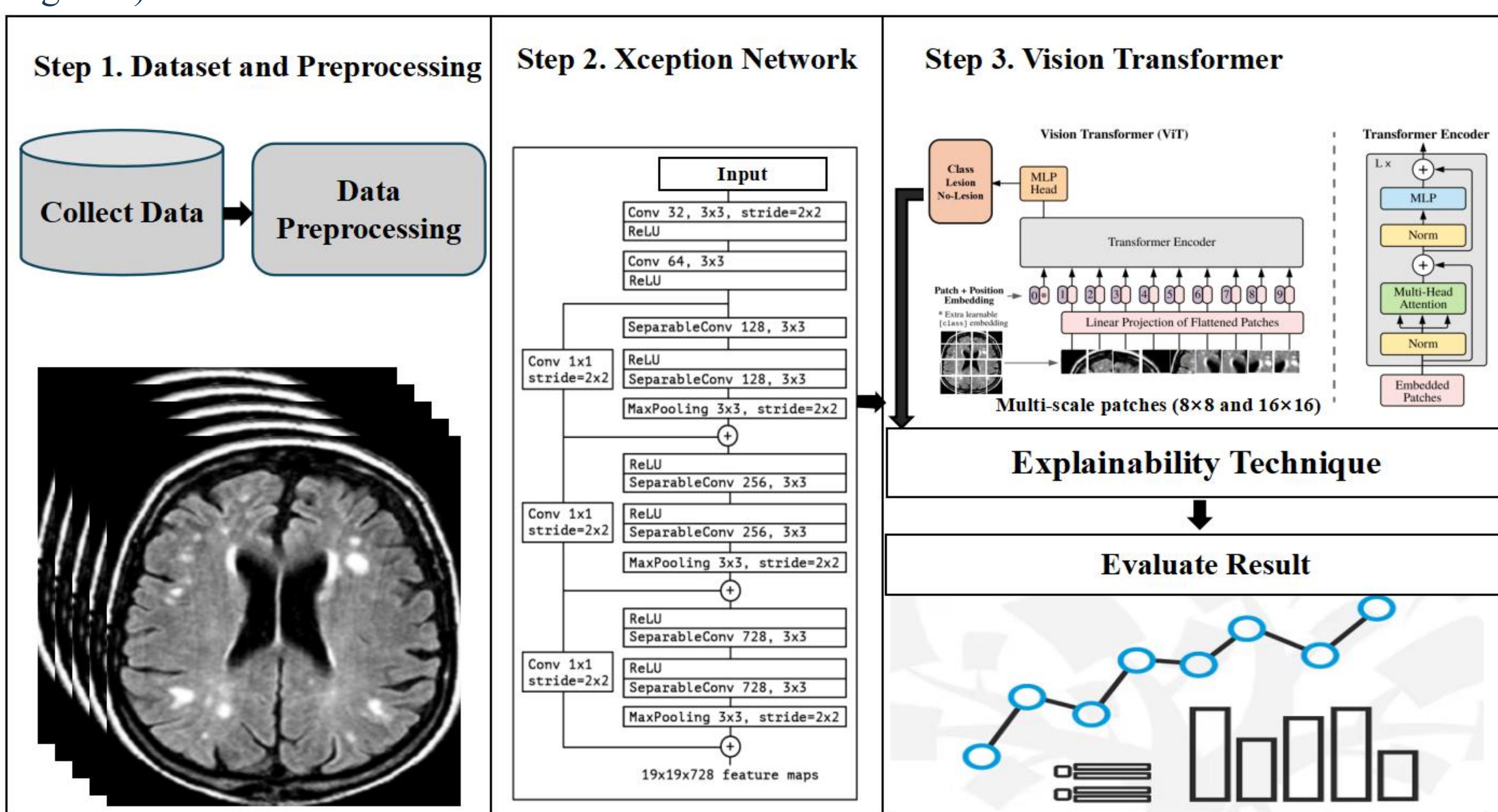


Figure 1: Proposed method

Plimentary Experiment & Results

Depth	Ac	P	Recall	FP	F1
30 Slices	0.67	0.75	0.75	0.46	0.75
50 Slices	0.76	0.75	0.94	0.56	0.84
100 Slices	0.67	0.71	0.83	0.63	0.77

Table 1: ResNet50

Depth	Ac	P	Recall	FP	F1
30 Slices	0.69	0.70	0.87	0.61	0.78
50 Slices	0.77	0.74	0.97	0.57	0.84
100 Slices	0.77	0.76	0.92	0.48	0.83

Table 2: A custom 3D-CNN

Depth	Ac	P	Recall	FP	F1
30 Slices	0.87	0.82	1.0	0.36	0.90
45 Slices	0.82	0.83	0.86	0.01	0.82
60 Slices	0.86	0.88	0.88	0.01	0.86

Table 3: A custom CNN+LSTM

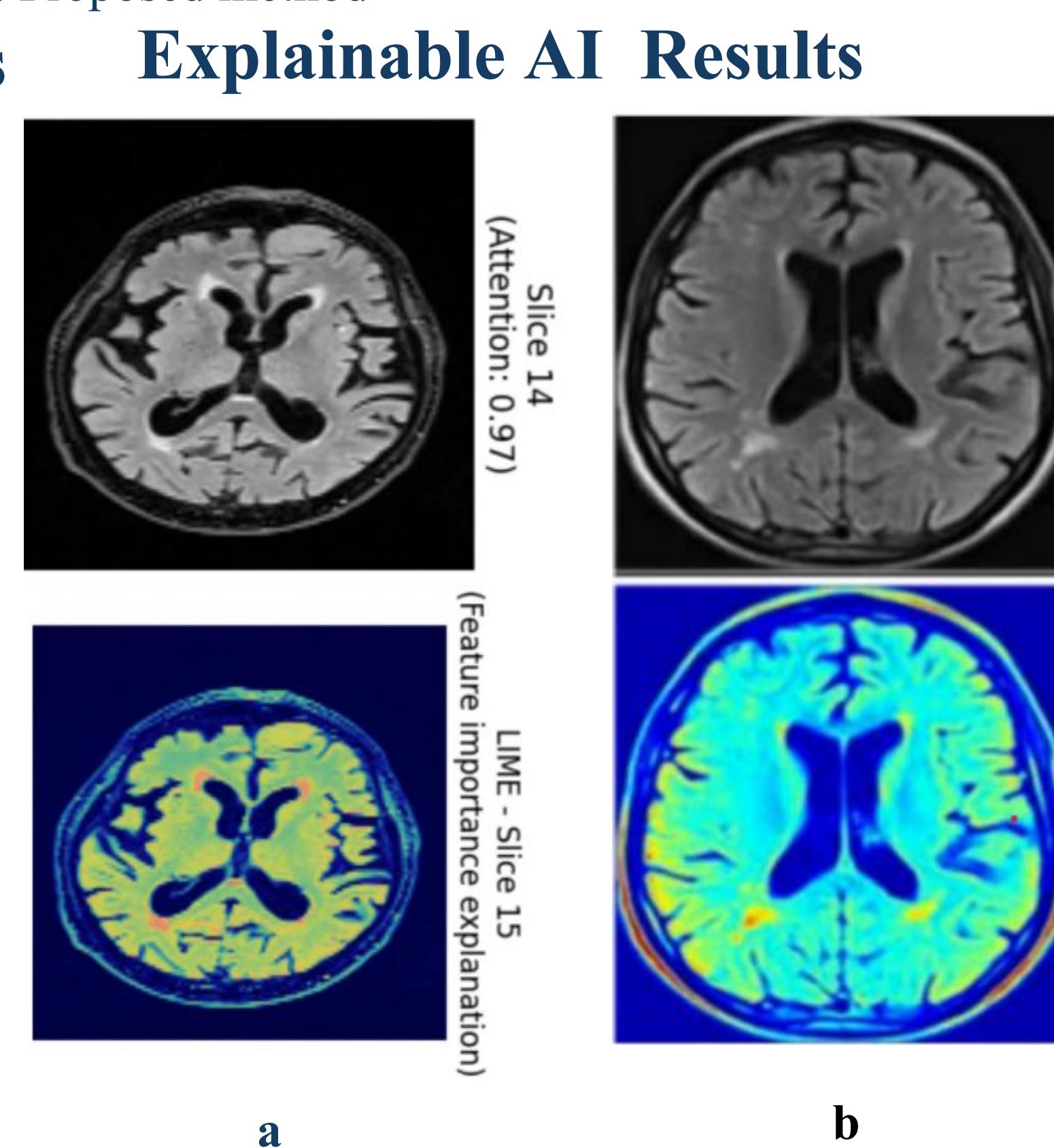


Figure 2: (a) LIME on 3D-CNN, (b) Grad CAM on ResNet-50 Visualizations

Future work

1. Resolve the imbalanced data .
2. Implement the proposed X-ViT method to detect small lesions.
3. Retrain the dataset with deep learning networks and XAI techniques.

References

- [1]. Prins, Niels D., and Philip Scheltens. "White matter hyperintensities, cognitive impairment and dementia: an update." *Nature Reviews Neurology* 11.3 (2015): 157-165.
- [2]. Dosovitskiy, Alexey. "An image is worth 16x16 words: Transformers for image recognition at scale." *arXiv preprint arXiv:2010.11929* (2020).