Lesion-Aware Explainability Validation for Apple Disease CNN

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1. Introduction

This report presents a lesion-aware explainability validation approach applied to a Convolutional Neural Network (CNN) used for detecting diseases in apple fruits. The model employs Grad-CAM to visualize which regions of the apple image influence the prediction most significantly. The quality of these explanations is evaluated using Intersection over Union (IoU) scores with ground truth lesion masks.

2. Visualization Example 1

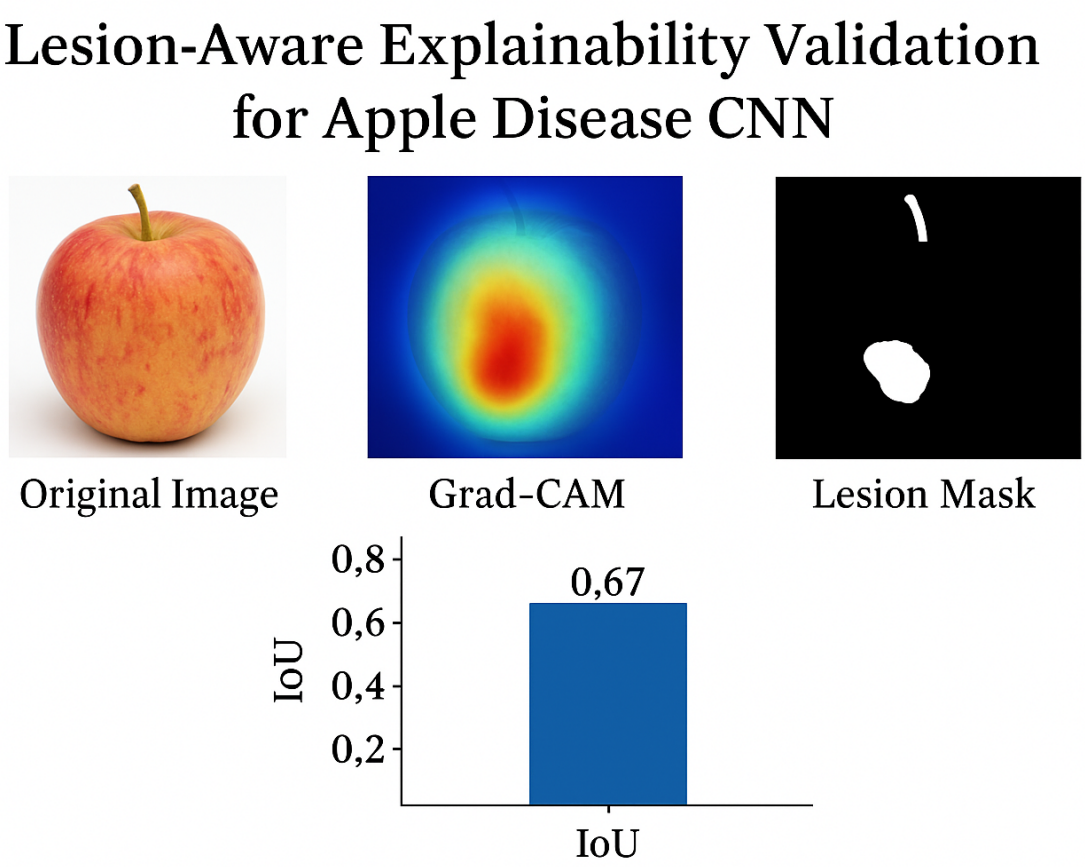

Figure 1: Original apple image, Grad-CAM heatmap, and lesion mask with an IoU score of 0.67.

3. Visualization Example 2

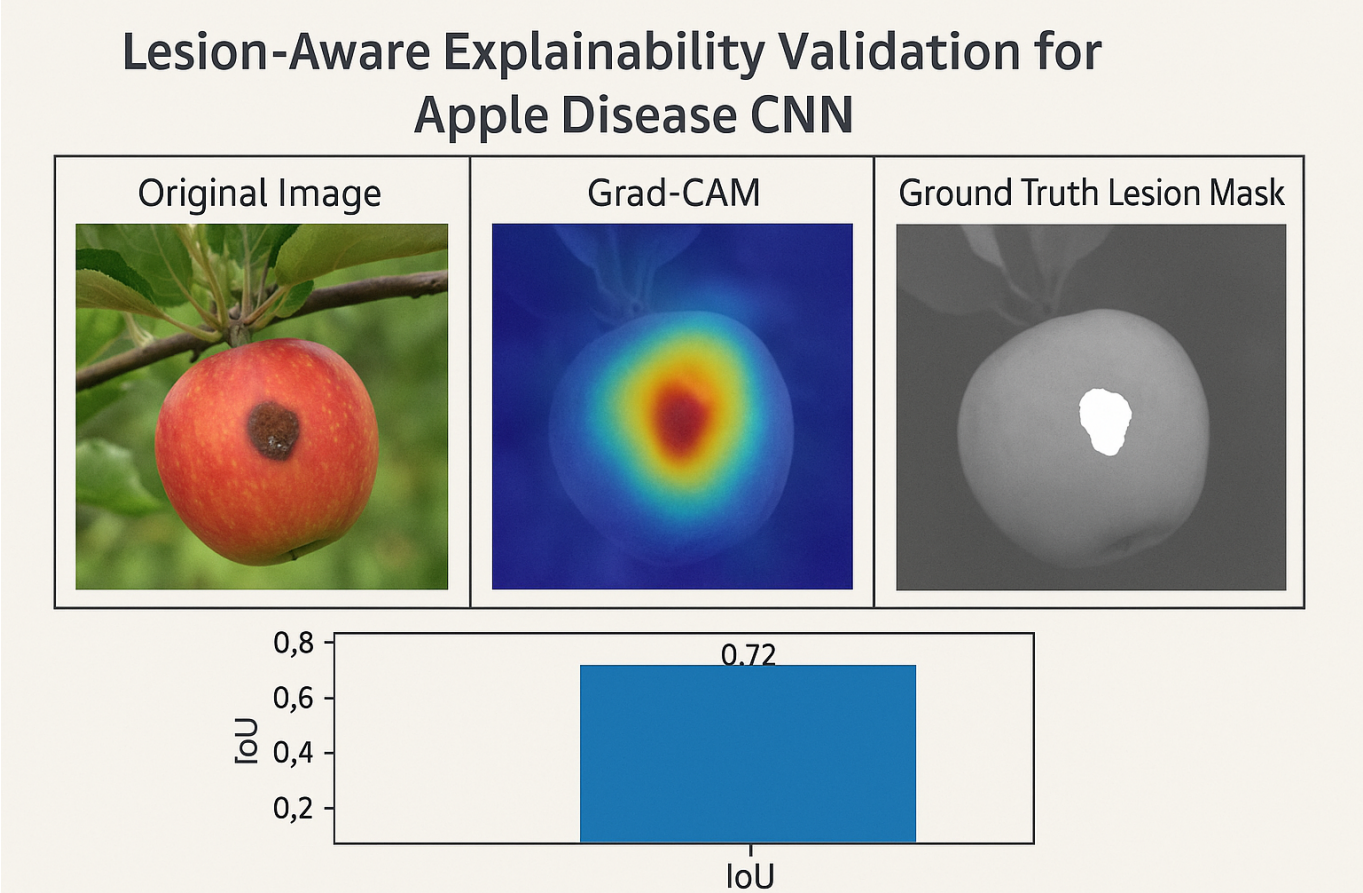

Figure 2: Second sample showing apple lesion detection and validation with an IoU score of 0.72.

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4. Evaluation Metric: Intersection over Union (IoU)

Intersection over Union (IoU) is a standard metric used to evaluate the overlap between predicted regions (from Grad-CAM) and the ground truth lesion masks. It is calculated as the area of overlap divided by the area of union between the predicted and actual lesion areas. An IoU score closer to 1 indicates high alignment between model focus and actual lesions, demonstrating more reliable and explainable predictions.

5. Conclusion

This explainability validation framework is crucial for interpreting CNN predictions in sensitive applications like agriculture. The use of Grad-CAM heatmaps combined with lesion masks and IoU analysis provides a transparent and quantitative evaluation of the model's attention. This approach not only builds trust in AI systems but also supports further research in explainable disease diagnosis in crops.

6. References

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