Dual View Mammogram Classification using Efficient-Net

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Background

1. Introduction (or educational background)

Mammograms remain the best method for screening for breast cancer (Wolfe et al., 2021).

However, current mammography screening methods face several challenges:

- Tumors in dense breast tissue are often hard to detect leading to additional imaging for women with dense breast tissue.
- Approximately 50% rate of inaccuracies which lead to unnecessary anxiety and missed diagnosis. (Bhushan et al., 2021)
- Substantial recall rate for supplemental MRI and Ultrasound diagnosis (Caines et al, 2022)

Recent advancements in deep learning have demonstrated promising results in automating cancer detection from medical images (ud Din et al., 2022).

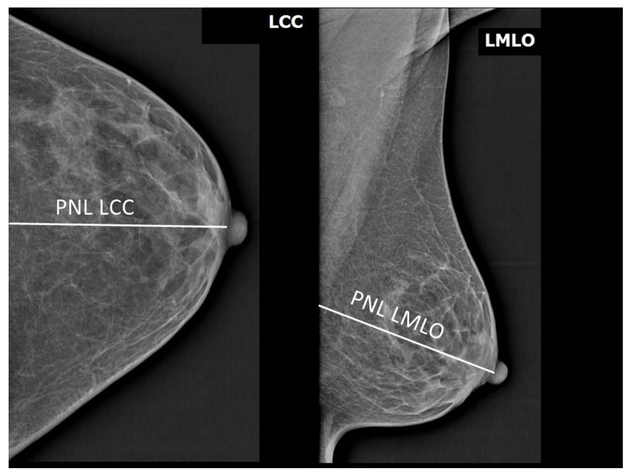


Fig. 1 *Atlas of Breast Cancer Screening Mammogram with CC and MLO views respectively*

2. Problem statement

- **Current Standard:** Mammograms use dual-view imaging Craniocaudal (CC) and Mediolateral Oblique (MLO) for comprehensive breast cancer detection (Wolfe et al., 2021).
- **Limitations of Existing AI Models:** Models analyze CC and MLO views independently, ignoring cross-view correlations. This leads to missed diagnoses (false negatives) and unnecessary recalls (false positives) (Zhiwei et al., 2022).
- **Proposed Solution:** Dual-view EfficientNet classifier that: Jointly extracts features from both views; Maximizes underlying correlations between CC/MLO and targets higher sensitivity/specificity than single-view models

Current Work

1. Objectives

Main Objectives:

Develop a dual-view classification model for accurate and efficient breast cancer detection.

Specific Objectives:

- Build a model that maximizes the feature-correlation across the dual-views using Efficient-Net.
- Compare single-view vs dual-view model performance.
- Achieve high accuracy while maintaining computational efficiency.

2. Methodology

1. Mammograms from CBIS-DDSM and INBreast Datasets were preprocessed, resized to 224 x 224 and pixel values were normalized.
2. A dual-branch architecture was built which processed CC and MLO views separately using Efficient-Net B0 is applied for both branches.
3. The feature vectors from the separate branches were then concatenated and passed through a classification layer CNN.
4. The model's performance was assessed using evaluation metrics such as precision, recall, F1-Score, AUC-ROC and a confusion matrix.

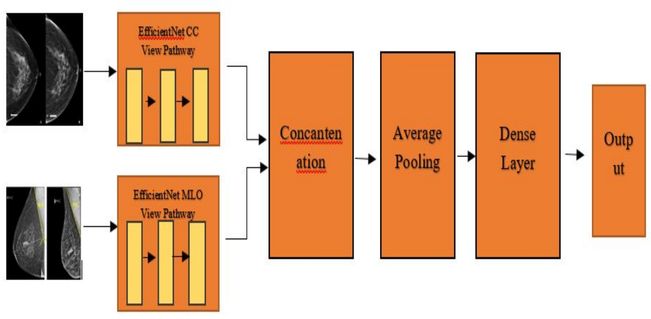
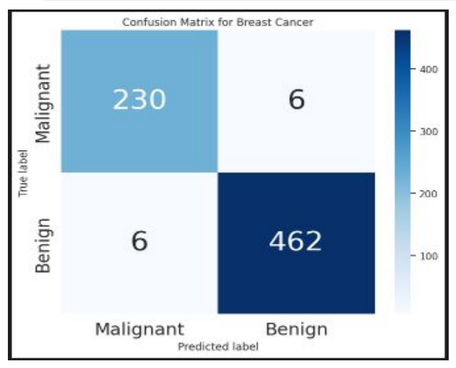


Fig. 2 *Dual-View mammogram model architecture*

3. Results

Epochs	Accuracy	Precision	Recall	AUC	F1-Score	Dataset
50	87.63%	91.04%	68.06	0.994	93	**INBreast**
100	76.03%	76.23%	78.03	0.84	72	**CBIS-DDSM**



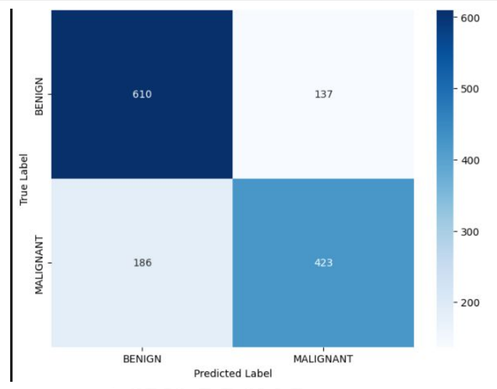
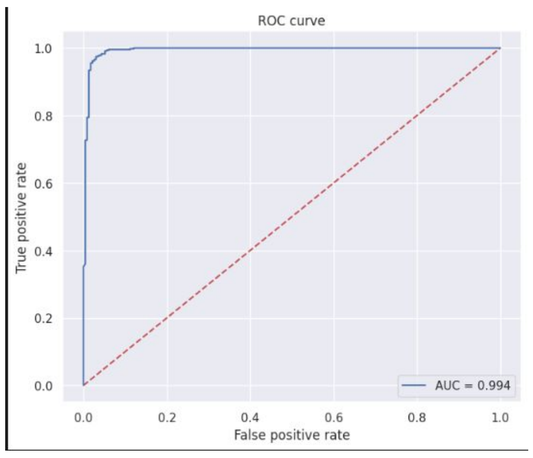


Fig. 3 *Confusion Matrix for the INBreast and CBIS-DDSM Datasets*



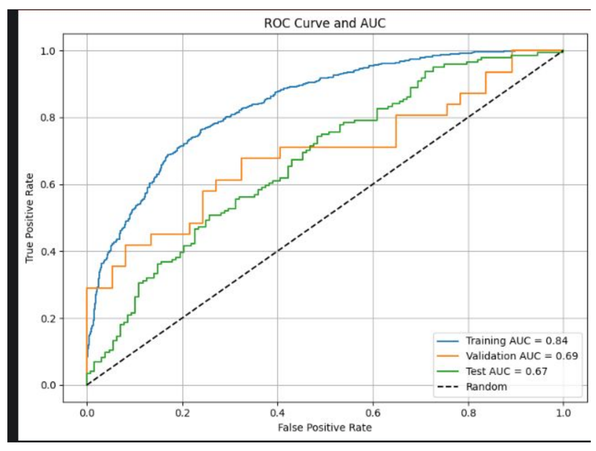


Fig. 4 *ROC on the INBreast Dataset and ROC-AUC on the CBIS-DDSM Dataset*

Conclusion & Expectations

An Efficient Net-based breast-wise abnormality detection network that predicted the probability of breast abnormality by considering both craniocaudal (CC) and mediolateral oblique (MLO) views.
This model makes use of the complementary data offered by both the craniocaudal (CC) and mediolateral oblique (MLO) views of mammograms.
The research represents a key step toward integrating deep learning and complementary mammographic views into clinical diagnosis.
Further work is being done to improve the model's performance(hyperparameter tuning and image augmentation) and additional analysis on African mammograms.

References & Acknowledgment (if needed)

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