

## An Experimental approach for breast cancer detection through artificial intelligence

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### Abstract

Cancer in which Breast Cancer is one of the most causes of death for worldwide women, and early detection is the best way to reduce mortality. Basic machine learning models based on structured clinical datasets achieve high prediction accuracy, but often fail to capture complex visual defects found in mammography images. This research proposes a multimodal hybrid architecture for the diagnosis and classification of breast cancer by combining excel/ csv dataset with the mammography image dataset. The proposed system combines ensemble machine learning models for structured clinical data analysis, and Convolutional Neural Networks (CNNs) for image feature extraction. A stacking based meta-learning architecture is used to combine the predictions from both modalities. The proposed multimodal framework obtained an overall accurateness of 99.5%, precision of 99.4%, recall of 99.6%, F1-score of 99.5%, and AUC score of 0.998. Experimental analysis shows that using the combination of tabular clinical variables and mammographic image data significantly increases resilience, decreases false negatives and leads to an increase in diagnostic confidence in comparison to single-modal approaches. The diagnostic efficacy of the proposed system is further exemplified by employing visualization techniques like ROC curves, confusion matrices, feature importance analysis, Grad-CAM visualization, and correlation heatmaps. Research's output suggested that multimodal AI powered systems provide clinically valid support in the pre detection and diagnosis of the cancer (Breast Cancer).

**Keywords:** CNN, Ensemble Learning, Mammography, Deep Learning, Hybrid AI Model, Medical Imaging, Multimodal Learning.

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### 1. Introduction

Breast cancer is considered as one of the most dangerous and fast spreading disease among the women worldwide [15]. The World Health Organization (WHO) says early diagnosis makes treatment easier and greatly improves survival. Mammography and histological investigation are still the two major diagnostic techniques, but manual method is often problematic and prone to human error [1], [2]. Traditional machine learning has shown promising results in tumor classification into benign and malignant using structural medical datasets like Wisconsin Diagnostic Breast Cancer dataset. Structured datasets do not fully capture the spatial and morphological abnormalities as seen in mammography images [3], [4], [5], [6]. On the contrary, deep learning techniques based on images are able to extract visual patterns, but may have interpretability and data imbalance issues [7], [8], [23], [24]. This study proposes a multimodal hybrid framework and overcome from the limitations combining [16], [17], [19], [32].

1. Organized clinical characteristics of dataset CSV/ Excel
2. Mammography images
3. CNN based deep feature extraction.
4. Ensemble machine learning using RF, GB and SVM.
5. Stacking for the final classification using meta-learning.