Optimized Hybrid Deep Learning Framework for Early Detection of Breast Cancer Using Image Processing Techniques

Publisher: IEEE

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Abstract:
Despite the progress that has been made on breast cancer diagnosis and therapy, it continues to be one of the most common causes of death in women due to late-stage detection associated with low specificities. While it is crucial to identify metastases at the initial stage, contemporary data-driven analytical models cannot appropriately classify tumors of small diameters due to their inability to detect minute structural differences and background tissue appearances. In this study, we introduced an improved hybrid deep learning model for the analysis of lung cancer CT images based on CNN-identified spatial features and attention-based transformer network that were used to provide contextual attention (CT) feature combined with radiomic-handcrafted features in order to perform comprehensive multi-level analyses. The architecture improves texture comprehending, refine charactering of lesion border and making better discrimination between benign or malignant regions. With its multi-branch fusion method, this system outperforms even state-of-the-art single task models by large margins. The experimental result also demonstrates that the proposed method outperforms classical models such as ResNet-50, VGG16 and EfficientNet-B0 with 98.7% accuracy, 98.3% precision, 99.1% recall and AUC-ROC of (Area Under ROC) is calculated to be at (AUC =~0•993). Those opposing results reinforce the orientation of stability and clinical utility. This helps with transparency for the radiologists and makes this model usable in practice. This hybrid approach thus augments the performing traditional imaging modalities with context learning, integration of radiomic features and serves as an objective diagnostic adjunct for aiding in early detection.

Published in: 2026 International Conference on Intelligent Computing, Networks, and Security (IC-ICNS)

Date of Conference: 26-28 March 2026

DOI: 10.1109/IC-ICNS68863.2026.11537446

Date Added to IEEE *Xplore*: 02 June 2026

Publisher: IEEE

ISBN Information:

Conference Location: Bhubaneswar, India

I. Introduction

Breast cancer continues to be a major health trouble globally and its lengths of survival relies upon on early diagnosis. Current diagnosis methods such as mammography and histology suffer from interpretive uncertainty, low penetration depth to identify both incident ductal carcinoma in situ (DCIS) and invasive cores found in deeper layers of breast tissue. Along with real-time diagnosed system must reorientation need advancement Current automated methods are largely based on individual deep learning models but cannot comprehensively capture the complexity of tumour shape, texture and context changes simultaneously with interaction between constituents in breast tissue. Moreover, these models tend to possess black box nature and reduce the clinical applicability. A comprehensive, smart and explainable diagnosis system is required to incorporated a multi-level factors in order to minimize the false negative rate thus improving accuracy. This is achieved by creating a more an advanced deep learning algorithm that integrating spatial, contextual and nuclear information along with higher robustness in addition to better clinical significance for the early diagnosis of breast cancer. This paper presents an overview of the importance and use of biomarkers, biosensors and microwave imaging in rapid detection of breast cancer which leads to fast image interpretation [1]. But it does not support deep learning integration. The importance of hybrid AI-based, multimodal early detection is understood. This article demonstrates that AI using deep learning can obtain increased than over 93.8% accuracy level for breast cancer detection and spells out salient features of latest techniques in resolution [2].

The approach also virtually omits hybrid-level feature fusion and explainability, which is a blueprint for advanced multimodal architecture design in our propos[illegible] limitations of screening, possible role for Deep Learning and data set challenges y[illegible] framework or benchmarks to assess performance Earth as in reference [3]. We learn how to enhance trustworthiness from hybrid architectures, resilient datasets and pragmatic evaluation. In this paper, we investigate medical imaging modalities and their diagnostic roles including recent machine learning advances in the age of improving MIP [4]. It is, however restricted in terms of coherent multimodal fusion as well as clinical appraisal, prompting exploration for integrative hybrid models with improved diagnostic credibility. This paper reveals essential attributes of cancer imaging systems like CT and MRI, by giving solid technical understanding [5] Attention against AI driven boosting techniques has been quite successful for letting us in to join imaging physics sophisticated deep learning know how, for more powerful dilemma identifying. This work describes several imaging modalities for disease detection without analysis of system performance but with some level of automation, [6] underscoring the need for hybrid deep learning frameworks and feature fusion, which our proposed system provides. This article presents and studies picture fusion methods and applications which offer to us insight but no medical specialized optimization of the fusion [7]. Their shortcomings highlight the need for a

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