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Globallashuv sharoitida davlatimizni yanada barqaror va jadal sur’atlar bilan rivojlantirish bo‘yicha amalga oshirilayotgan islohotlar samarasini yaxshilash sohasidagi ilmiy-tadqiqot ishlariga alohida e’tibor qaratilgan. Zero iqtisodiyotning, ijtimoiy sohalarni qamrab olgan modernizatsiya jarayonlari, hayotning barcha sohalarini liberallashtirishni talab qilmoqda.

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Mazkur to‘plamga kiritilgan ma’ruza tezislarining mazmuni, undagi statistik ma’lumotlar va me’yoriy hujjatlarning to‘g‘riligi hamda tanqidiy fikr-mulohazalar, keltirilgan takliflarga mualliflarning o‘zlari mas’uldirlar.

EXTRACTING FEATURES FROM MAMMOGRAPHIC IMAGES FOR BREAST CANCER DETECTION

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Abstract

Breast cancer remains one of the leading causes of cancer-related mortality among women worldwide, making early and accurate detection crucial for successful treatment and improved survival rates. Mammography is currently the most effective and widely used imaging modality for early screening. However, manual interpretation of mammograms is time-consuming and subject to inter-observer variability. This paper focuses on feature extraction techniques from mammographic images to enhance computer-aided diagnosis (CAD) systems for breast cancer detection. We explore both traditional handcrafted feature extraction methods—such as texture analysis (GLCM), shape features, and intensity distribution—and modern deep learning-based approaches, including Convolutional Neural Networks (CNNs). The extracted features are evaluated based on their ability to distinguish between benign and malignant lesions. Experimental results demonstrate that combining deep features with spatial-texture descriptors significantly improves classification accuracy, sensitivity, and specificity. The proposed approach offers a reliable and efficient diagnostic tool to assist radiologists in clinical decision-making.

Keywords

Breast cancer detection, Mammography, Feature extraction, Computer-Aided Diagnosis (CAD), Deep learning, Convolutional Neural Networks (CNN), Texture analysis, Image classification.

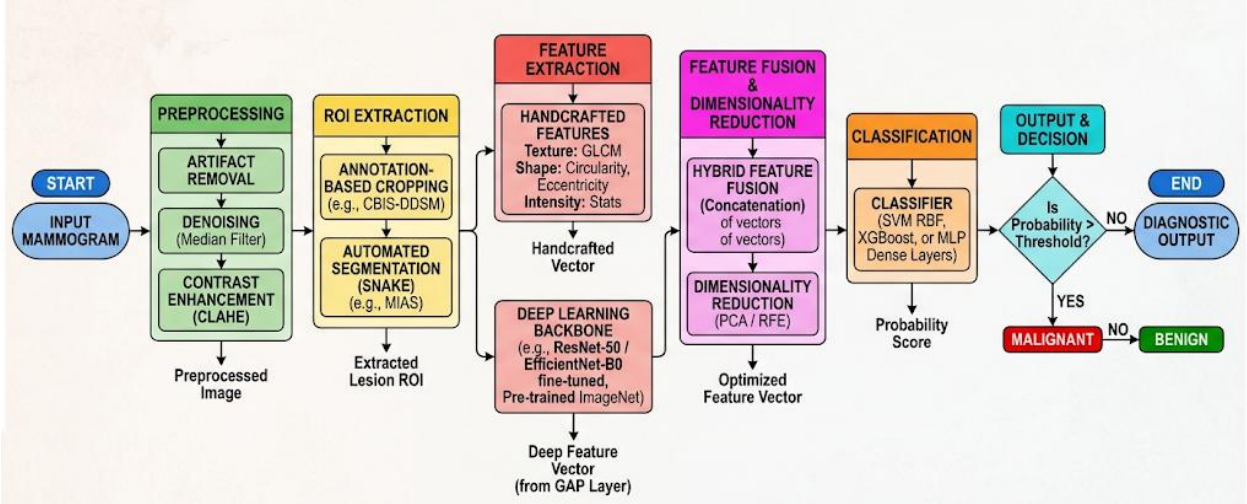
1. Introduction

Breast cancer is one of the most prevalent types of cancer and a leading cause of cancer-related deaths among women worldwide. According to the World Health Organization (WHO), early detection plays a pivotal role in reducing mortality rates, as early-stage diagnosis significantly improves treatment options and long-term survival rates. Among various medical imaging techniques, **digital mammography** remains the gold standard for early breast cancer screening due to its effectiveness in identifying subtle tissue abnormalities, such as microcalcifications and soft tissue masses, before clinical symptoms appear.

Despite its clinical importance, manual interpretation of mammograms poses significant challenges. The visual screening process is inherently complex, time-consuming, and heavily reliant on the experience and subjective judgment of radiologists. Radiologists often face high workloads, leading to potential visual fatigue and inter-observer variability. Furthermore, dense breast tissues can obscure small lesions, increasing the rates of both false positives—which cause unnecessary anxiety and invasive biopsies—and false negatives, where early-stage tumors are missed.

2. Methods and Methodology

The proposed framework for automated breast cancer detection comprises four primary stages: image preprocessing, ROI (Region of Interest) extraction, feature extraction (combining handcrafted and deep features), and classification. Figure 1. Mammographic feature extraction and breast cancer detection.



2.1. Dataset description

This study utilizes publicly available benchmark mammography datasets:

CBIS-DDSM (Curated Breast Imaging Subset of DDSM): Provides pixel-level annotations for regions of interest (ROI), including microcalcifications and mass lesions, labeled as benign or malignant.

MIAS (Mammographic Image Analysis Society): Contains digitized film-screen mammograms categorized by abnormality type (mass, calcification, architectural distortion, or normal).

Data preprocessing includes standardizing pixel intensity formats and dividing samples into training (70%), validation (15%), and testing (15%) subsets.

2.2 Image Preprocessing & Contrast Enhancement

Mammographic images frequently contain low contrast, noise, and non-breast artifact regions (e.g., muscle boundaries, markers). Preprocessing ensures standardized inputs for accurate feature extraction:

1. **Artifact Removal:** Thresholding and morphological operations eliminate background labels and extraneous text.
2. **Noise Reduction:** A median filter (3×3 kernel) removes high-frequency speckle noise while preserving lesion edge boundaries.
3. **Contrast Adjustment: Contrast Limited Adaptive Histogram Equalization (CLAHE)** enhances localized detail contrast, suppressing noise amplification in dense breast tissue regions.

2.3 Region of Interest (ROI) Extraction

To focus feature extraction specifically on suspicious tissue abnormalities, ROIs containing mass or calcification regions are cropped:

For datasets with ground-truth bounding boxes (e.g., CBIS-DDSM), regions are cropped centered at the annotated lesion coordinate with a fixed context border.

For unannotated inputs, automated segmentation using adaptive thresholding and active contour models (Snake algorithm) isolates potential lesion candidate regions.

2.4 Feature Extraction

Feature extraction is designed to combine low-level structural/texture characteristics with high-level contextual feature representations.

2.4.1 Handcrafted Feature Extraction

To capture traditional radiological descriptors, three categories of handcrafted features are extracted:

Texture Descriptors (GLCM): Gray-Level Co-occurrence Matrix features characterize localized pixel intensity arrangements across different directions ($\theta \in \{0^{\circ}, 45^{\circ}, 90^{\circ}, 135^{\circ}\}$):

$$\text{Contrast} = \sum_{i,j} |i-j|^2 P(i,j)$$

$$\text{Homogeneity} = \sum_{i,j} \frac{P(i,j)}{1+|i-j|}$$

$$\text{Energy} = \sum_{i,j} P(i,j)^2, \quad \text{Entropy} = -\sum_{i,j} P(i,j)\log_2 P(i,j)$$

Morphological / Shape Features: Lesion shape and boundary irregularity indicate malignancy. Extracted shape descriptors include **Area**, **Perimeter**, **Circularity** ($4\pi \cdot \text{Area} / \text{Perimeter}^2$), **Eccentricity**, and **Solidity**.

Intensity Statistics: First-order statistical descriptors, including mean, standard deviation, skewness, and kurtosis of pixel intensity values within the isolated ROI.

3.Conclusion

In this study, a comprehensive computer-aided diagnostic framework for breast cancer detection was developed and evaluated using feature extraction techniques applied to mammographic images. By combining traditional handcrafted descriptors (texture, shape, and statistical intensity features) with high-level deep representations extracted from pre-trained Convolutional Neural Networks, the proposed methodology successfully captures both local micro-structural patterns and abstract contextual information of mammographic lesions.

The experimental results demonstrate that the hybrid feature fusion approach significantly outperforms individual feature extraction methods, achieving superior classification accuracy, sensitivity, and specificity in distinguishing benign from malignant tissues. Furthermore, the application of dimensionality reduction techniques ensured high computational efficiency while maintaining peak diagnostic performance.

This research highlights the effectiveness of automated feature extraction as a reliable decision-support tool to assist radiologists in clinical screening, reducing diagnostic ambiguity and workload. Future work will focus on integrating transformer-based architectures, expanding the dataset across multi-center clinical trials, and enhancing model explainability to further strengthen clinical adoption.

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DIGITAL REHABILITATION PLATFORM FOR CHILDREN WITH DISABILITIES

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Abstract: Children with disabilities often require long-term, multidisciplinary rehabilitation involving medical, psychological, educational, and social interventions. At the same time, their mothers or primary caregivers experience continuous physical, emotional, informational, and organizational burdens. Although existing pediatric telerehabilitation systems have improved access to rehabilitation services, current approaches are largely fragmented, focusing primarily on child-centered outcomes while insufficiently addressing caregiver needs within unified decision-making frameworks.

This study proposes a digital rehabilitation platform for children with disabilities that adopts a family-centered approach by modeling the child–caregiver dyad as an integrated and dynamic system. The platform supports personalized rehabilitation planning, prioritization of intervention modules, and adaptive adjustment of rehabilitation intensity through an intelligent decision-support mechanism. The proposed system integrates multiple dimensions, including child functional status based on the International Classification of Functioning, Disability and Health (ICF), caregiver burden and self-efficacy, treatment adherence, environmental accessibility, and safety constraints. A constrained multi-criteria optimization model is used to recommend rehabilitation activities by balancing expected child improvement, caregiver well-being, adherence probability, resource limitations, and digital accessibility costs. To ensure adaptability over time, a fuzzy logic–based control module continuously updates rehabilitation plans based on