Zeina Ahmed 320210137

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**Breast Cancer Detection Report**

**Abstract**

Breast cancer remains one of the leading causes of mortality among women worldwide. Early and accurate detection is crucial for effective treatment and improved survival rates. This report presents the development of an image processing and machine learning-based approach to enhance ultrasound breast images for breast cancer classification. The study focuses on advanced image preprocessing techniques, including median filtering, histogram equalization, contrast stretching, Sobel filtering, and Laplacian filtering, to improve the visibility of critical features for subsequent classification using a convolutional neural network (CNN).

**Problem Definition**

Breast cancer diagnosis challenges include variability in tumor appearance and the presence of noise and artifacts in ultrasound imaging. These factors can hinder the effective interpretation and classification of benign and malignant tissues. Therefore, enhancing the quality of ultrasound images and developing robust algorithms for accurate classification is essential.

**Objectives**

The project aims to enhance the diagnostic capabilities of ultrasound imaging for breast cancer by:

**Noise Reduction**: Minimizing noise to prevent obscuration of crucial tissue details.

**Contrast Enhancement**: Enhancing image contrast to better delineate features indicative of malignancy.

**Feature Enhancement**: Utilizing edge detection filters to emphasize structural boundaries that are key in differentiating between benign and malignant lesions.

**Automated Classification**: Developing a CNN model to classify the processed images into benign or malignant categories, aiding in rapid and accurate diagnosis.

**Methodology**

The methodology involves processing and analyzing a dataset of ultrasound breast images sourced from a publicly available Kaggle dataset. The images undergo several preprocessing steps using Python and libraries such as OpenCV and scikit-image:

* **Median Filtering**: Reduces salt-and-pepper noise prevalent in ultrasound images.
* Histogram Equalization: Enhances image contrast by adjusting the image's histogram, making the structures more distinct.
* **Contrast Stretching**: Normalizes the brightness and improves contrast across images to ensure that all images are evaluated under similar conditions.
* **Sobel Filtering**: Detects edges in both horizontal and vertical directions, highlighting potential tumor boundaries.
* **Laplacian Filtering**: Enhances edges and fine details, critical for the detailed analysis of tissue structures.

These preprocessed images are then fed into a CNN, designed and trained to classify the images into benign or malignant categories based on learned features from the training data.

**Results and Interpretation**

The preprocessing and classification pipeline developed for this project provided significant improvements in image quality and classification accuracy:

* **Noise Reduction**: The median filter effectively removed extraneous noise, resulting in clearer image details.
* **Contrast Enhancement**: Adjustments made through histogram equalization and contrast stretching made subtle differences in tissue density more apparent, which are crucial for early detection.
* **Edge and Feature Enhancement**: Sobel and Laplacian filters successfully highlighted critical boundaries and textures associated with malignant growths.
* **Classification Accuracy**: The CNN model achieved a high level of accuracy, demonstrating the effectiveness of combining advanced image processing with deep learning for breast cancer diagnosis.

The enhancements in image processing and classification techniques described in this report could potentially be integrated into clinical workflows, providing support for radiologists in making more accurate and timely breast cancer diagnoses. This approach underscores the benefits of combining image processing with machine learning to improve diagnostic outcomes in medical imaging.















