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A COMPARATIVE ANALYSIS OF PERSISTENT HOMOLOGY AND DISCRETE WAVELET TRANSFORM IN BREAST MAMMOGRAPHY IMAGE CLASSIFICATION USING CONVOLUTIONAL NEURAL NETWORK

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ABSTRACT

Breast cancer is one of the top causes of death among women worldwide. Early detection through mammography plays a crucial role in improving survival rates. As the most widely used imaging technique for early breast cancer screening, mammography is often regarded as the “gold standard”. However, due to poor image quality, it is hard to diagnose cancer accurately. This study compares two advanced methods, Persistent Homology (PH) from Topological Data Analysis, and a signal processing method is Discrete Wavelet Transform (DWT) for effectiveness in filtering and feature extraction on images of the breast mammography. The study used Digital Database for Screening Mammography (DDSM), which includes images containing microcalcifications. Both methods were used to preprocess the images and extract features that were used for classification. The PH features consisted of persistent image and persistent entropy, while DWT features such as mean, energy, standard deviation, Shannon’s entropy, kurtosis and skewness. Based on these features, a Convolutional Neural Network (CNN) was used to classify the images to either benign or malignant. The comparative analysis indicate that PH provides more accuracy and outperforms DWT in all performance metrics. The best results of PH were achieved at the filter level 0.3 with accuracy at 97.55%, precision at 96.18%, f-measure at 97.62%, sensitivity at 99.20%, and specificity at 95.97%. This implies that PH is more effective in capturing image details which makes it better for utilize in deep learning model. These findings may help improve breast cancer screening by supporting earlier and more accurate diagnosis.

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