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PST004 - MAMMOAI: AUTOMATED MAMMOGRAPHIC BREAST CANCER CLASSIFIER POWERED BY AUTOML

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ABSTRACT

MammoAI is a breakthrough AI-powered system designed to revolutionize breast cancer screening through fully automated mammographic image analysis. Developed using the state-of-the-art Auto-Sklearn AutoML framework, MammoAI integrates advanced image enhancement, tumor segmentation, and optimized machine learning pipelines to classify breast tumors with high precision. This product addresses the critical need for consistent, scalable, and accurate diagnostic tools, particularly in regions with limited radiological expertise. The innovation combines Contrast Limited Adaptive Histogram Equalization (CLAHE) and Active Contour Method (ACM) for robust tumor delineation, followed by extraction of 37 key radiomic features. These are then processed through MammoAI's smart ensemble learning engine, achieving 76.16% test accuracy and 0.86 AUC after optimization. Designed with scalability, speed, and minimal user input in mind, MammoAI holds strong commercialization potential as a clinical decision support system that augments radiologist workflow, reduces diagnostic delays, and enhances early detection outcomes.

Keywords – Mammography, Breast Cancer, Radiomics, AutoML, Auto-Sklearn

INTRODUCTION

Breast cancer is the most common cancer affecting women globally, accounting for 2.3 million new cases annually (Sung et al., 2021). Despite mammography being the gold standard for early detection, interpretation inconsistencies and limited access to skilled radiologists remain major bottlenecks. With increasing demand for faster and more accurate diagnostics, AI-driven solutions are essential to modern healthcare delivery. MammoAI was conceived to automate and enhance mammographic cancer detection through an end-to-end AutoML-driven platform that minimizes human bias and maximizes diagnostic performance.

OBJECTIVE

To develop MammoAI, an AI-based mammography analysis system that automates image enhancement, tumor segmentation, feature extraction, and cancer classification, offering a scalable solution to enhance diagnostic accuracy and accessibility.

DESCRIPTION OF THE PROJECT

MammoAI introduces an end-to-end diagnostic pipeline that integrates AI technologies with radiological image analysis to assist clinicians in breast cancer detection. The process begins with image enhancement using Contrast Limited Adaptive Histogram Equalization (CLAHE), which improves contrast across localized regions of mammographic images, making subtle lesions more detectable. This is followed by semi-automated tumor segmentation utilizing the Active Contour Method (ACM), which iteratively refines tumor boundaries to accurately capture the shape and size of suspicious regions. Once segmented, the system extracts 37 radiomic features from each image, encompassing first-order statistics, GLCM-based texture features, and shape descriptors to quantitatively represent the tumor's morphology and heterogeneity. These features are input into the Auto-Sklearn framework, an AutoML platform that automatically selects and optimizes machine learning models through ensemble learning and Bayesian optimization. Using this method, MammoAI effectively classifies tumors as benign or malignant. The system was validated using 244 DICOM mammographic images sourced from the CBIS-DDSM and DDSM public databases. Results show a significant improvement in diagnostic performance, with classification accuracy rising from 55.10% to 76.16%, and AUC increasing from 0.64 to 0.86 after model tuning and data resampling. MammoAI not only offers a rapid and reproducible solution but is also scalable for integration into hospital PACS systems or as a cloud-based diagnostic service.

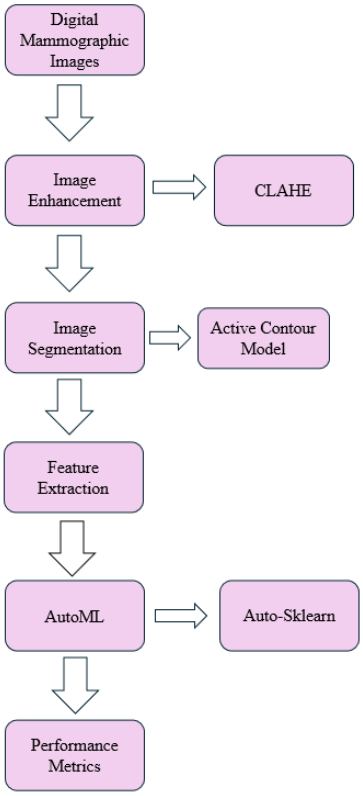

Figure 1: MammoAI processing pipeline from image input to classification output

Table 1: MammoAI classification performance before and after optimization

Metric	Standard	MammoAI Optimized
Accuracy	55.10%	76.16%
Precision	60.90%	70.40%
Recall	53.80%	76.00%
AUC-ROC	0.64	0.86

NOVELTY

MammoAI stands out by embedding a full AutoML pipeline into the radiology workflow, offering zero-code automation for radiomic analysis. The use of CLAHE-ACM pre-processing and Tuning-Ensemble N-Best strategy in Auto-Sklearn for mammography is a novel approach not widely commercialized. Unlike static rule-based systems, MammoAI evolves with more data, making it adaptable to different datasets, breast densities, and clinical environments. It's scalable for cloud deployment, making it an ideal candidate for telemedicine, AI-as-a-service, and diagnostic centers.

CONCLUSION

MammoAI is an innovative AI-based solution poised to transform mammographic cancer diagnostics. With its fully automated workflow, validated performance, and high scalability, MammoAI has strong commercialization potential for hospitals, diagnostic labs, and mobile screening units. By augmenting radiologist capabilities and accelerating early detection, MammoAI has the potential to significantly improve breast cancer outcomes nationwide.