EXPLAINABLE AI FOR BREAST CANCER DETECTION IN MAMMOGRAPHY

L.L.M. Wickremesinghe

229406T

Degree of Master of Computer Science

Department of Computer Science and Engineering
Faculty of Engineering

University of Moratuwa
Sri Lanka

January 2025

EXPLAINABLE AI FOR BREAST CANCER DETECTION IN MAMMOGRAPHY

L.L.M. Wickremesinghe

229406T

Dissertation submitted in partial fulfillment of the requirements for the degree
Degree of Master of Computer Science

Department of Computer Science and Engineering
Faculty of Engineering

University of Moratuwa
Sri Lanka

January 2025

DECLARATION

I declare that this is my own work and this Dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: Date: 30-06-2025

The supervisor should certify the Dissertation with the following declaration.

The above candidate has carried out research for the Degree of Master of Computer Science Dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Dr. Thanuja D. Ambegoda

Signature of the Supervisor: Date: 30-06-2025

ACKNOWLEDGEMENT

I am grateful to Dr. Thanuja D. Ambegoda for his invaluable assistance in identifying an engaging research topic and for his unwavering support and encouragement. His guidance was pivotal in setting goals and enhancing my study engagement. I extend my heartfelt thanks to the Department of Computer Science and Engineering at the University of Moratuwa for their assistance in overcoming challenges. Lastly, I want to express deep appreciation to my family for their steadfast support throughout this journey.

ABSTRACT

Breast cancer remains a significant global health concern among women. This research introduces an explainable AI-assisted breast cancer detection system aimed at improving both the accuracy and interpretability of mammogram-based diagnoses. The study utilizes high-quality mammographic datasets, CBIS-DDSM and the RSNA Screening Mammography dataset, to train and validate the models.

The system uses two powerful deep learning models: Convolutional Neural Networks (CNNs) and Vision Transformers (ViTs). The InceptionResNetV2 CNN achieved an accuracy of 92%, while the ViT model reached 96% accuracy by effectively focusing on important regions in the mammogram images. To make the system more transparent, several Explainable AI (XAI) methods were applied, including Grad-CAM, SIDU, Attention Maps, and Ablation-CAM. Among these, SIDU provided the clearest and most accurate visual explanations, which are valuable for medical decision-making.

To further improve the reliability and clinical value of the system, this study introduces a Dual-Stage Ensemble Diagnosis and Decision Fusion Framework. This approach combines the diagnostic strengths of both models to deliver a more confident and balanced final decision, supported by detailed visual explanations. The platform consist with a user-friendly web application that allows doctors and patients to easily upload mammogram images and receive AI-based predictions with clear and interpretable outputs. This research helps advance the development of trustworthy AI tools for breast cancer detection in real clinical settings.

Keywords: Explainable AI(XAI), Breast Cancer, Convolutional Neural Networks(CNN), Vision Transformers (ViT), Mammogram, Medical Imaging

TABLE OF CONTENTS

LIST OF FIGURES