Benign and Malignant Detection and Classification for Small Size Image of Breast Tumor Recognition System using U-Net Model

*Suryanti Awang
Faculty of Computing
Universiti Malaysia Pahang Al-Sultan Abdullah
Pekan, Malaysia
suryanti@umpsa.edu.my

Saumya Kumar
Faculty of Computing
Universiti Malaysia Pahang Al-Sultan Abdullah
Pekan, Malaysia
CB20095@student.umpsa.edu.my

Nur Syafiqah Mohd Nafis
Faculty of Computing
Universiti Malaysia Pahang Al-Sultan Abdullah
Pekan, Malaysia
nsyafiqahmnafis@umpsa.edu.my

Raihanah Haroon
Kuliyyah of Medicine
International Islamic Universitiy of Malaysia
Kuantan, Malaysia
raihanahharoon@iium.edu.my

2024 5th International Conference on Artificial Intelligence and Data Sciences (AiDAS) | 979-8-3315-2855-3/24/$31.00 ©2024 IEEE | DOI: 10.1109/AIDAS63860.2024.10730254

***Abstract*— Breast tumor recognition is a critical task in the field of medical imaging systems, aiming to differentiate between benign and malignant tumors. To differentiate the tumors, an efficient technique is crucial to detect and classify it to avoid misdetection and misclassification, at the same time can accelerate the process. Thus, this paper proposed a deep learning technique which is a modified architecture of U-net model that based on Convolutional Neural Network (CNN) to detect and classify the tumors. The aim is to have a less complex U-Net model that is effective for a small size of images. During the technique deployment, data augmentation, transfer learning, and ensemble approach are employed. The proposed technique is tested using Breast Ultrasound Images dataset (BUSI) that is available in Kaggle. The results obtained are promising with accuracy of 0.8, precision of 0.88, recall of 0.7, and F1-score of 0.8. It indicates that this technique can contribute to the advancement of breast tumor detection and classification by providing valuable insights for clinicians in making accurate and timely diagnoses. Thus, the proposed technique has the potential to improve the efficiency and effectiveness of breast tumor recognition, aiding in the early detection and treatment of breast cancer.**

Keywords*— Deep Learning, Biomedical Image Segmentation, Pattern Recognition

I. INTRODUCTION

Breast cancer is one of the top 5 malignancies affecting women worldwide. It is the second-leading cause of cancer-related deaths and the most prevalent cancer affecting women [1]. The procedure of finding breast cancer and classifying the tumor is essential for delivering efficient care and raising survival rates. The procedure of classifying the tumor in breast whether the breast tissue is benign or malignant is known as breast tumor classification. This procedure is crucial to be completed efficiently in terms of time and accuracy to avoid misdetection and misclassification as well as to avoid it spreading to other regions of the body. The classification procedure can be assisted by implementing deep learning models on mammography images [2-3]. The procedure that implemented the models should be able to accelerate the detection and classifying process in the breast tumor recognition system. One of the ways to accelerate it is by having a less complex model to process small size of breast tumor images and produce comparable classification performance. However, the images are often affected by noise that can originate from various sources, including equipment malfunction or patient movement. This noise can significantly impact the accuracy of the models designed for breast tumor classification, making it challenging to differentiate between benign and malignant tumors. Thus, we focus on the implementation of U-Net model that is based on CNN architecture. We design the model to be suitable with the small size of images and at the same time able classify the tumor accurately.

There are many other deep learning models that can be implemented in this problem domain, including transfer learning, recurrent CNN (RCNN), deep belief networks (DBN) and extreme learning machines (ELM) [4-6]. However, among these deep learning, CNN is better for solving the problem with breast tumor classification due to the backpropagation with gradient descent method. The method efficiently optimizes their parameters (weights and biases) to minimize the loss function. The gradients computed during backpropagation guide the updates to the model's parameters in the direction that reduces the loss, leading to convergence towards a better solution [7]. Thus, it plays a crucial role in training CNNs effectively, allowing them to learn complex patterns and representations from data while optimizing for generalization and efficiency. Note that benign and malignant breast tumors are complex patterns since they are identical to our naked eyes.

U-Net model is one of the CNN architectures that is effective for medical images segmentation where accurate delineation of tumor pattern from images is crucial. Its ability to capture both local details and global context through skip connections makes it well-suited for such tasks [8]. The pretrained U-Net model will be employed to capture and extract relevant features from the mammography images, focusing on areas indicative of breast tumors.

Authorized licensed use limited to: Universiti Malaysia Pahang Al Sultan Abdullah (UMPSA).. Downloaded on December 04,2024 at 06:46:06 UTC from IEEE Xplore. Restrictions apply.