Chapter 4
Breast Cancer Detection Using Machine Learning: A New Frontier in Early Diagnosis

Priyanka Pradhan
https://orcid.org/0000-0001-5892-9312
Regional College of Professional Studies and Research, India

Afshan Zameer
Rakshpal Bahadur Management Institute, India

Manvi Mishra
http://orcid.org/0000-0001-6764-3789
SRMS College of Engineering Technology and Research, Bareilly, India

Kirti Seth
https://orcid.org/0009-0003-6582-9549
School of Computer Science and Engineering, INHA University, Tashkent, Uzbekistan

ABSTRACT

Breast cancer remains one of the most widespread and life-threatening diseases affecting women worldwide. The early detection and accurate diagnosis of breast cancer are crucial for reducing death rates and improving patient outcomes. Machine learning (ML), a subset of artificial intelligence, has recently emerged as a powerful tool in the healthcare sector, offering promising solutions to the challenges posed by traditional diagnostic methods. This chapter aims to present a comprehensive exploration of how machine learning techniques can revolutionize the process of breast cancer detection and classification. It delves into a wide array of ML algorithms, data acquisition techniques, feature extraction, model evaluation

DOI: 10.4018/979-8-3373-4312-9.ch004

metrics, and real-world implementation challenges, providing a solid theoretical and practical foundation for researchers, practitioners, and students. The vision is to create a holistic and accessible resource that not only informs but also inspires further innovation in the use of ML for breast cancer detection.

1. INTRODUCTION

Breast cancer continues to be one of the deadliest cancers impacting women across the globe. It is marked by abnormal cell proliferation within the breast, which often results in a tumor that can be visualized on imaging studies or palpated as a lump. The etiology of breast cancer is complex and includes genetic factors (like mutations in BRCA1 and BRCA2), hormonal changes, lifestyle choices, and specific genes. Some of the common symptoms are lumps in the breast, change/s in its shape,skindimpling,pain, and nipple discharge. Global statistics indicate it is the most diagnosed cancerous tumor among women, maintaining a prominent position as one of the highest contributors to oncological mortality. There is no question that early detection significantly improves prognosis. Early stage diagnosis directly correlates with successful treatment outcomes. Enhanced awareness coupled with screening services has proven to improve both early diagnosis and survival rates. Modern diagnostic techniques such as mammograms, ultrasound scans,and biopsies continue to play a pivotal role in breast cancer detection.

Nevertheless, these methods face challenges such as high expenses, false positives/negatives, invasive procedures, and difficulty accessing remote areas. Much recently, there have been advancements in technology with healthcare Machine Learning (ML) emerging as a new promising approach on cancer detection and prognosis. With the ability to assess and analyze large datasets, ML algorithms capture intricate correlations and can make precise predictions far surpassing traditional diagnostic techniques. The aim of integrating ML systems into breast cancer detection is to improve accuracy and promptness of diagnosis while aiding in clinically informed decisions.

This chapter outlines crucial matters relating to breast cancer including the need for timely interventions alongside an assessment of the fundamental issues within standard diagnostic practice followed by the application of machine learning aimed at improving detection and prevention methodologies. The following sections will focus on ML models and associated datasets, performance benchmarks, as well as prospects for future work in this area.