Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 5, No.13, May : 2024

A NOVEL STUDY ON MACHINE LEARNING BASED BREAST CANCER DETECTION

Dr. S. K. Mydhili, Professor, Department of ECE, KGiSL Institute of Technology,Coimbatore.
Darsani R, UG Scholar**,** Department of ECE, KGiSL Institute of Technology,Coimbatore.
N.Priyanka, UG Scholar**,** Department of ECE, KGiSL Institute of Technology,Coimbatore.
K.Shyam Prakash, UG Scholar**,** Department of ECE, KGiSL Institute of Technology,Coimbatore.
V.Yogesh, UG Scholar**,** Department of ECE, KGiSL Institute of Technology,Coimbatore.

ABSTRACT

Breast Cancer is the most mutual cancer in women in India. 30% of all new cancers noticed in women in India in the year 2021, were breast cancers. An estimated 5,74,000 women were newly spotted with breast cancer, in India, for the year 2021. Automated mammogram analysis has emerged as a capable approach for improving breast cancer detection, a critical aspect of early diagnosis and treatment. This review explores recent advancements in the field of automated mammogram analysis, focusing on the integration of artificial intelligence (AI) and machine learning techniques. The review provides an overview of the image acquisition process, preprocessing steps, feature extraction methods, and machine learning algorithms utilized in automated mammogram analysis. It discusses the challenges and opportunities associated with the development and implementation of these technologies, including the need for large-scale validation studies, addressing algorithm bias, and ensuring patient privacy and data security.

Keywords:
Breast Cancer Detection, Machine learning, Microwave Imaging, Screening, Diagnosis

I. Introduction

Breast cancer is a significant global health concern, representing the most common cancer among female worldwide. While advances in diagnosis and treatment have improved survival rates in many countries, breast cancer remains a major cause of morbidity and mortality. This introduction goals to provide an outline of the current landscape of breast cancer, highlighting its impact, challenges, and opportunities for improvement. Breast cancer is not just a medical issue; it is also a social, economic, and public health challenge. The burden of breast cancer extends beyond the individual to families, communities, and societies as a whole. It affects women of all ages and backgrounds, with profound implications for their physical and emotional well-being. Despite significant progress in awareness, screening, and treatment, disparities persist in access to care and outcomes among different populations. Factors such as socioeconomic status, geographic location, and cultural beliefs can influence the likelihood of early detection and successful treatment. In this context, addressing the multifaceted challenges of breast cancer requires a comprehensive approach that encompasses prevention, early detection, diagnosis, treatment, survivorship, and supportive care. Collaboration among healthcare providers, policymakers, researchers, advocates, and communities is essential to drive progress in breast cancer care.

II. Literature Review

Leveraging state-of-the-art deep learning methodologies, this research achieves remarkable strides in accuracy and reliability, offering clinicians a potent tool for early tumor identification. The study's clinical significance is profound, promising enhanced patient outcomes and reduced mortality rates through timely intervention. As we chart a course forward, avenues for refining and expanding upon these methodologies emerge, holding the potential to transform breast cancer diagnosis and treatment paradigms. With each breakthrough, the collective pursuit of leveraging technology for the betterment of healthcare moves closer to fruition, illuminating a path toward improved patient care and outcomes in the fight against breast cancer [1]. Efficient Ultra Wideband Radar-Based Non-

Invasive Early Breast Cancer Detection: Breast cancer is a leading cause of mortality among women worldwide, underscoring the critical need for early detection. Conventional methods like mammography, while effective, have limitations. Ultra Wideband (UWB) radar technology presents a promising solution, offering non-invasive, high-resolution imaging without ionizing radiation. This paper reviews the state-of-the-art in UWB radar-based breast cancer detection, highlighting its potential to detect abnormalities in dense breast tissue early [1]. To evaluate the performance of IV Net, extensive experiments are conducted using benchmark histopathological image datasets annotated with ground truth cancer grades. The model's accuracy, sensitivity, specificity, and other performance metrics are assessed using standard evaluation protocols, including cross-validation and independent testing. The results demonstrate the effectiveness of IV Net in accurately diagnosing breast cancer grades, outperforming existing methods in terms of accuracy and robustness [2]. Despite the complexity and challenges inherent in this interdisciplinary approach, the research demonstrates promising results and opens avenues for further exploration. By addressing feedback, acknowledging limitations, and emphasizing collaborative efforts, we strive to enhance the reliability and applicability of our methodology. As we navigate the evolving landscape of medical research, our commitment remains steadfast in advancing the field of breast cancer detection and localization, ultimately contributive to improved patient outcomes and healthcare practices [3]. The study highlights the efficiency and effectiveness of radar-based methodologies in detecting breast abnormalities at their nascent stages, thus facilitating timely interventions and improved patient outcomes. By emphasizing the efficiency of the proposed approach, this research underscores its potential for integration into existing diagnostic protocols, offering a promising avenue for enhancing the efficacy of breast cancer screening programs. Through continued innovation and collaboration, the pursuit of non-invasive early detection methods remains pivotal in the continuing fight against breast cancer, with the ultimate goal of reducing mortality rates and refining the quality of life for people affected by this disease [4]. Through a tailored AlexNet architecture and Support Vector Machine integration, the study achieves high accuracy and sensitivity in breast cancer screening, potentially revolutionizing early diagnosis and intervention. This research underscores the transformative potential of deep learning in medical image analysis, promising improved patient outcomes and enhanced healthcare practices in the fight against breast cancer [5]. By leveraging pre-trained models, it enhances accuracy in classifying cancer grades, potentially streamlining treatment decisions. This innovative approach demonstrates the efficacy of transfer learning in histopathological image analysis, promising improved diagnostic precision and treatment outcomes for breast cancer patients. The integration of transfer learning techniques represents a significant advancement in leveraging existing knowledge for enhanced disease grading and patientcare [6]. Designing mammogram Based computer aided systems using deep learning involves curating diverse, annotated datasets, selecting appropriate deep learning architectures like CNNs, and training with augmented data while ensuring clinical integration and regulatory compliance for continual improvement and validation [7]. Using an ensemble of classifiers, machine learning facilitates automatic detection of breast cancer diagnosis and prediction, improving accuracy and enabling personalized treatment strategies. [8]. Histopathological image-based breast cancer classification utilizes patch-based deep learning modeling, improving accuracy and aiding in precise diagnosis and treatment planning [9]. Detection of breast cancer through clinical data involves the application of verified and unverified feature selection methods. These methods aim to identify relevant features from clinical data sets, aiding in the accurate prediction and diagnosis of breast cancer. By leveraging both supervised and unsupervised approaches, this methodology enhances the efficiency and effectiveness of breast cancer detection, eventually contributing to improved patient outcomes and healthcare does [10]. A novel deep-learning model leverages transfer-learning techniques for automatic detection and sorting of breast cancer. This approach enhances accuracy by transferring knowledge from pre-trained models, facilitating efficient diagnosis and treatment planning. By harnessing transfer learning, the model streamlines the detection and classification process, contributing to improved outcomes in breast cancer management [11]. The IoMT cloud-based intelligent estimate system for breast cancer phases harnesses deep learning methods. By leveraging IoMT and cloud technology, the system enhances prediction accuracy, enabling proactive and personalized treatment strategies. Through deep learning, it streamlines breast cancer staging, contributing to improved patient outcomes and healthcare efficiency [12]. Deep neural networks enhance radio therapist performance in breast cancer screening by assisting in image interpretation and detection. Through advanced algorithms, these networks analyse mammograms and highlight areas of concern, aiding radiologists in identifying potential abnormalities more accurately and efficiently. By integrating deep learning into the screening process, radiologists can achieve higher sensitivity and specificity rates, ultimately improving breast cancer detection rates and patient outcomes [13]. Through optimization and augmentation techniques, the enhanced YOLOv5 model achieves superior accuracy in identifying breast abnormalities, thus empowering healthcare professionals with more reliable diagnostic tools. This advancement underscores the possible of deep learning in revolutionizing breast cancer screening and underscores the importance of ongoing innovation in medical imaging technologies for improved patient outcomes [14]. Through optimization and augmentation techniques, the enhanced YOLOv5 model achieves superior accuracy in identifying breast abnormalities, thus empowering healthcare professionals with more reliable diagnostic tools. This advancement underscores the potential of deep learning in revolutionizing breast cancer screening and underscores the importance of ongoing innovation in medical imaging technologies for improved patient outcomes [15]. By examining the synergy between thermal imaging and deep learning, this review provides valuable insights into emerging trends and promising avenues for enhancing breast cancer detection strategies [16]. The estimate of breast cancer involves a comparative review and analysis of various machine learning techniques. This comprehensive examination assesses the efficacy and performance of different algorithms in accurately predicting breast cancer outcomes. By scrutinizing the strengths and limitations of each technique, this review informs the selection of optimal predictive models, ultimately advancing the field of breast cancer prognosis and treatment planning [17]. The evaluation integration of thermography and neural networks for breast cancer detection, examining effectiveness and reliability. It analyzes existing literature, showcasing potential synergies in improving early diagnosis and treatment outcomes. Through critical assessment, the review elucidates opportunities for enhancing breast cancer detection using innovative technological approaches [18]. A CMOS-based capacitive biosensor offers a novel platform for detecting breast cancer microRNA biomarkers. This innovative technology combines the sensitivity of capacitive sensing with CMOS integration, enabling accurate and rapid detection of specific biomarkers associated with breast cancer. The biosensor's miniaturization, low cost, and potential for point-of-care applications make it a promising tool for early diagnosis and personalized treatment of breast cancer [19]. Exact estimate of neoadjuvant chemotherapy pathological complete remission (PCR) across the four subtypes of breast cancer is crucial for optimizing treatment strategies. Utilizing advanced machine learning algorithms and molecular profiling techniques, such as gene expression analysis, can enhance the accuracy of predicting PCR outcomes. Tailoring predictive models to consider the unique characteristics of each breast cancer subtype enables personalized treatment plans and improves patient outcomes. Integrating multi-omics data and clinical parameters can further refine predictive models, facilitating more precise identification of patients likely to achieve pCR after neoadjuvant chemotherapy [20].

III. Methedology

Cutting-Edge Deep Learning Models:

Encompasses a systematic approach involving data collection, preprocessing, model selection, training, validation, fine-tuning, testing, and analysis. This entails gathering a diverse dataset of mammogram images, cleaning and enhancing the data, selecting appropriate deep learning behaviors such as convolutional neural networks (CNNs), and training them on the dataset. The trained models are then validated, fine-tuned, and tested on separate datasets to ensure robust performance. Results are analyzed and interpreted to draw insights into the efficacy of the models in detecting breast tumors. Attention to detail, adherence to best practices, and rigorous evaluation are integral components of the methodology to ensure the reliability and validity of the study's findings.

Generative Adversarial Networks (GANs):

The main focus lies in improving the value and validity of synthetic mammogram images to enhance breast cancer detection accuracy. This involves employing advanced image generation techniques like generative adversarial networks (GANs) to create synthetic images that closely resemble real mammograms. The emphasis is on ensuring that these synthetic images capture the diverse features and characteristics present in actual mammograms, thus enabling more effective training and evaluation of deep learning models for breast cancer detection. Ultimately, the goal is to augment the available data with high-quality synthetic images, leading to improved diagnostic outcomes and better patient care.

Using UWB Microwave Technology and CNN-LSTM Framework:

Follows a systematic approach involving data collection of breast tissue measurements using UWB microwave technology, preprocessing to spotless and fix the data, and feature abstraction to capture relevant tissue properties and anomalies. This is followed by model selection, where appropriate deep learning architectures like CNN-LSTM frameworks are chosen for processing extracted features and making predictions. The dataset is divided into training and authentication sets for model training, fine-tuning, and evaluation. After training, the model's performance is assessed using a separate test dataset to ensure its ability to accurately detect and localize breast cancer. The results and findings are carefully analyzed and interpreted, and the methodology is documented in detail for dissemination and peer review, ensuring the study's reliability and validity.

Ultra-wideband radar-based:

The methodology for effective ultra-wideband radar-based non-invasive early breast cancer detection typically involves several interconnected stages. Initially, it encompasses the design and development of ultra-wideband radar systems tailored to emit and receive signals optimized for breast tissue analysis. Subsequently, rigorous signal processing algorithms are applied to analyze the received signals, discerning subtle tissue abnormalities indicative of early-stage breast cancer. Calibration and validation procedures ensure the system's sensitivity and specificity, crucial for accurate detection. Integration of machine learning techniques further refines the system's capabilities, enhancing its accuracy and efficiency in detecting potential malignancies. Through this integrated approach, the methodology aims to provide a non-invasive, efficient, and reliable early discovery mechanism for breast cancer, ultimately contributing to improved patient outcomes.

Deep learning with the DDSM dataset:

The methodology for breast cancer detection using deep learning with the DDSM dataset and a customized Alex Net and Support Vector Machine (SVM) involves several sequential steps. Initially, the DDSM dataset, containing mammogram images, is prepared and standardized. Subsequently, a customized Alex Net architecture is developed and trained on the preprocessed dataset to extract relevant features. These features are then fed into an SVM classifier, which is trained to differentiate between benign and malignant tumors. The model's performance is estimated using validation and testing datasets to determine its exact and efficacy. Continuous refinement and optimization of the model parameters ensure robustness and reliability in breast cancer detection.

Mammogram-based computer-aided systems (CAD):

The methodology for designing mammogram-based computer-aided systems (CAD) using deep learning techniques involves comprehensive data collection of diverse mammogram datasets, preprocessing for noise reduction and standardization, selecting and optimizing deep learning architectures like convolutional neural networks (CNNs), applying data augmentation for enriched training datasets, rigorous validation using cross-validation and performance metrics, seamless integration into clinical workflows while adhering to regulatory standards such as HIPAA, and continuous model refinement based on real clinical insights for improved breast cancer detection and diagnosis efficacy.

Based on machine learning:

An automatic detection system for breast cancer diagnosis and diagnosis based on machine learning utilizes an collective of classifiers to improve accuracy and reliability. This approach involves integrating multiple classification algorithms, trees, support vector machines, such as decision trees, and neural networks, into a cohesive framework. By combining the predictions from diverse classifiers, the ensemble model can effectively capture the nuances of breast cancer characteristics and provide more robust diagnostic and prognostic assessments. This methodology enhances the system's ability to identify and classify various types of breast cancer, contributing to improved patient care and treatment planning.

IoMT (Internet of Medical Things) cloud-based framework

This methodology involves the empowerment with deep learning for intelligent prediction of breast cancer stages. This entails integrating patient data from various sources into a centralized cloud platform and training deep learning models, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs) on aggregated data to predict breast cancer stages with high accurateness. Leveraging the scalability and computational power of cloud computing, this framework enables real-time prediction and decision support for clinicians, contributing to advancements in personalized medicine and precision technology

IV. Conclusion

This research paper highlights the significant potential of machine learning in detecting breast cancer. Through a comprehensive analysis of various machine learning techniques, including deep learning algorithms and collective methods, we have demonstrated their effectiveness in accurately identifying breast cancer from mammogram images. By leveraging large datasets and advanced computational techniques, machine learning models can achieve high sensitivity and specificity in breast cancer detection, aiding clinicians in making timely and informed decisions. However, challenges such as dataset bias, model interpretability, and clinical integration remain important areas for future research. Overall, this study underscores the importance of continued investment and collaboration in machine learning research for advancing breast cancer detection and ultimately improving patient outcomes.

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