# SURVEY ON BREAST CANCER DETECTION USING CNN ALGORITHM

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## ABSTRACT

*Breast cancer continues to be one of the leading causes of female death globally. Proper and early disease diagnosis is critical to the maximization of the survival rate of the patients. This research proposes an artificial intelligence-based system for the early detection and classification of breast cancer using deep learning models—specifically Convolutional Neural Networks (CNNs)—for the analysis of mammographic images. The proposed system seeks to detect and classify microcalcifications, which are critical signs of breast cancer, into three precise classes: normal, benign, and malignant.The architecture adheres to a pipeline-based system of image preprocessing, feature extraction, and classification. This rigorous framework improves detection precision, significantly reducing false positives. Additionally, for supplementary analysis via image, the system integrates a symptom-based cancer staging estimation module. The question-and-answer interface of this feature estimates cancer staging stages (0 to 4) to serve as a complementary diagnostic tool for non-image-based cases.The integration of imaging analysis with staging prediction greatly enhances the accuracy of the diagnostic tool without reducing the workload that the radiologists and medical professionals have to handle. By enabling faster and more accurate diagnostic results, the system seeks to improve clinical outcomes, particularly in low-resource environments where expert radiologists may not be present.This research demonstrates the transformational capability of artificial intelligence technology in the medical imaging industry with a valuable and scalable solution to identify breast cancer earlier. The results indicate that the diagnostic devices with the assistance of AI have the potential to serve as integral support systems in contemporary healthcare by facilitating improved early intervention planning and improved treatment.*

**Keyword: -** *Breast cancer detection, Convolutional Neural Networks (CNNs), Symptom-Based Cancer Staging, Image Preprocessing, Feature Extraction, Flask .*

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## 1. INTRODUCTION

Breast cancer continues to be a leading cause of morbidity and mortality in women worldwide. Early and accurate diagnosis is required to improve clinical results and patient survival. Advances in artificial intelligence (AI) and deep learning have provided new possibilities for the design of computer-aided diagnostic (CAD) systems to enhance the efficacy and reliability of medical image analysis.This study proposes an artificial intelligence-based detection and classification system, namely to identify microcalcifications in mammography images—tiny calcium deposits that are potential indicators of breast cancer. The system is centered on a Convolutional Neural Network (CNN) architecture, which is better at learning and developing complex features from mammograms. The proposed system in this study automates the diagnostic process, from image preprocessing, feature extraction, to classification of abnormalities into three classes: normal, benign, or malignant.In addition to image-based diagnosis, the system suggested involves a symptom-led cancer staging module. Following a systematized question-and-answer protocol, it approximates disease progression through stages outlined (0 to 4), providing full diagnostic support in situations where imaging data alone may not be adequate.By minimizing false positives, lowering diagnostic subjectivity, and streamlining clinical decision-making, this AI-powered CAD tool aims to help radiologists provide faster, more precise diagnoses. The system's capability to automate otherwise time-consuming tasks without compromising diagnostic performance is proof of its potential to be integrated into current clinical workflows without disruption.In short, the work seeks to provide a scalable, smart diagnostic tool that will augment the detection and staging of breast cancer earlier, thus allowing timely intervention and better long-term outcomes for the patients.

## 2. MILESTONES

The article titled "Breast Cancer Classification From Histopathological Images Using Patch-Based Deep Learning Modeling" by Irum Hirra, Mubashir Ahmad, Ayaz Hussain, M. Usman Ashraf, Iftikhar Ahmed Saeed, Syed Furqan Qadri, Ahmed M. Alghamdi, and Ahmed S. Alfakeeh presents a significant contribution to medical image analysis. The authors proposed a novel deep learning framework called Pa-DBN-BC, which uses a Deep Belief Network (DBN) for accurate breast cancer classification from histopathological images. Unlike traditional methods, this model extracts features automatically from image patches sized 32×32 pixels, removing the need for manual feature engineering. The DBN architecture includes both an unsupervised pre-training phase and a supervised fine-tuning phase, making it highly adaptive to complex image data. A logistic regression classifier with a sigmoid function is employed to categorize the patches into cancerous or non-cancerous regions. The dataset used in the study comprises 177 grayscale images from four different institutions, ensuring diversity in imaging techniques. The model achieved an impressive accuracy of 86%, outperforming several recent CNN-based architectures in sensitivity and error rate. Image preprocessing steps such as grayscale conversion, thresholding, and Gaussian filtering were applied to enhance classification performance. Hyperparameters were optimized using a random search method to ensure training stability and better generalization. The authors conclude that their patch-based DBN model not only reduces computational cost but also offers a reliable approach for future multi-class breast cancer classification.

The article titled "A Novel Deep Learning based Framework for the Detection and Classification of Breast Cancer Using Transfer Learning" by SanaUllah Khan, Naveed Islam, Zahoor Jan, Ikram Ud Din, and Joel J. P. C. Rodrigues introduces a deep learning framework to improve breast cancer diagnosis using cytology images. The authors utilize transfer learning to enhance three well-known CNN architectures: GoogLeNet, VGGNet, and ResNet. These architectures are pre-trained on the ImageNet dataset and fine-tuned on cytology images to classify benign and malignant cells. The study emphasizes the importance of transfer learning, especially when medical image datasets are limited in size. Data augmentation techniques such as rotation, scaling, and flipping are applied to increase the dataset and reduce overfitting. The combined CNN model outperforms the individual architectures in classification accuracy, achieving 97.52%, which is higher than comparable existing methods. Performance is evaluated on datasets including a standard benchmark and a local dataset from LRH hospital in Peshawar. Results show the framework's strength across various magnification levels (100X to 500X). The study highlights the framework’s effectiveness in automating breast cancer diagnosis while reducing manual interpretation errors. In conclusion, the authors suggest future improvements by integrating handcrafted features with CNN-based models to further enhance classification accuracy.

The paper "Breast Cancer Detection Using Extreme Learning Machine Based on Feature Fusion With CNN Deep Features" introduces a computer-aided diagnosis (CAD) system to improve breast cancer detection accuracy. It highlights the limitations of traditional CAD methods that rely heavily on handcrafted features and radiologist expertise. To address this, the authors propose a hybrid approach that combines both deep learning and traditional features. CNNs are used to extract deep features from mammogram sub-regions, while morphological, texture, and density features are also included to form a fused feature set. An Extreme Learning Machine (ELM) classifier is then employed to distinguish between benign and malignant tumors. The study incorporates a novel sub-regional clustering method using unsupervised ELM (US-ELM) for mass detection. The proposed method is tested on 400 mammograms, showing superior performance compared to other existing techniques. Evaluation metrics such as accuracy, sensitivity, and AUC validate its effectiveness. The results demonstrate that fusing subjective and objective features enhances diagnostic precision. Overall, this integrated CAD framework offers a promising solution for early breast cancer detection.

The paper titled "Deep Learning Model Aids Breast Cancer Detection" discusses a new approach using deep learning to enhance early breast cancer diagnosis. Breast cancer remains one of the most common cancers globally, and early detection is crucial for improving patient outcomes. Traditional diagnosis methods are being increasingly supplemented by deep learning models that analyze medical images with higher accuracy. The authors introduce a modified SE-ResNet-50 architecture, enhanced with a generalized mean pooling layer and the Adam optimizer, to improve classification performance. They also address data imbalance in breast cancer datasets by applying data augmentation techniques. Their method transforms the diagnosis into a binary classification task, evaluated using the weighted F1 score. In their experiments, the proposed model outperformed other popular architectures like GoogleNet and EfficientNet. The model achieved a weighted F1 score of 0.52, indicating a good balance between precision and recall. These results show that the refined architecture offers better detection accuracy compared to standard models. Ultimately, this research contributes to the development of more effective and efficient medical AI tools for breast cancer diagnosis.

The book “Fuzzy Models and Algorithms for Pattern Recognition and Image Processing” presents a comprehensive overview of how fuzzy logic can be applied to solve problems in pattern recognition and image processing. Pattern recognition is defined as the classification or categorization of input data into meaningful classes based on extracted features. Fuzzy models allow for more flexible decision-making by accommodating uncertainty and partial truths, which is often necessary when dealing with real-world data. The authors discuss different types of data and label representations, including crisp, fuzzy, probabilistic, and possibilistic labels. A major portion of the text is devoted to clustering techniques, especially fuzzy c-means, which enables objects to belong to multiple clusters with varying degrees of membership. Classifier design is another core focus, encompassing prototype-based methods, neural-like architectures, and fuzzy rule-based systems. Image processing applications are explored with techniques such as edge detection, segmentation, and fuzzy region representation. The book emphasizes the importance of selecting appropriate models based on the nature of data and desired outcomes. It also discusses practical challenges like data corruption and the impact of algorithmic parameters on outcomes. Overall, the text demonstrates how fuzzy logic bridges human-like reasoning and computational models in complex pattern recognition scenarios.

The article titled “Identification of Abnormal Masses in Digital Mammography Images” presents a novel technique to aid in the early detection of breast cancer. The study emphasizes the importance of digital mammography as a reliable method for identifying abnormalities like masses and calcifications. The authors propose a two-part technique involving the formation of homogeneous blocks and color quantization, aimed at simplifying the mammogram image for better analysis. These processes help in highlighting distinct regions that could potentially represent abnormal tissues. Using texture features extracted from gray-level co-occurrence matrices (GLCM), the technique evaluates contrast, homogeneity, and energy to distinguish between normal and abnormal regions. The methodology was tested on over 100 images from the MIAS database, and results demonstrated clear visibility of masses after processing. The paper notes that masses typically show higher pixel density and contrast compared to normal tissue, making them detectable using the proposed method. Histograms and color maps further support the visual differentiation between normal and abnormal mammograms. The technique was found to be computationally simple yet effective, making it suitable for real-time diagnostic systems. Overall, the research contributes a promising tool for assisting radiologists in faster and more accurate diagnosis of breast abnormalities.

The article "Intelligent Ultrasound Imaging for Enhanced Breast Cancer Diagnosis: Ensemble Transfer Learning Strategies" proposes a powerful system for classifying ultrasound images of breast cancer using deep learning. Breast cancer remains one of the leading causes of death among women globally, and early detection is crucial for improving survival rates. This research combines transfer learning (using Inception V3, VGG-16, and VGG-19 models) with ensemble machine learning techniques to boost classification accuracy. The system classifies ultrasound images into three categories: benign, malignant, and normal. It uses pre-processing, feature extraction, and advanced classifiers like Support Vector Machines and Multi-Layer Perceptrons with different architectures. The system was tested using the publicly available UBC ultrasound dataset consisting of 780 images. Among all models, Inception V3 combined with a stacking ensemble achieved the highest accuracy (85.8%) and AUC (94.7%). The results show that this approach outperforms traditional methods in diagnosing breast cancer using ultrasound images. The study emphasizes the importance of data augmentation and cross-validation to enhance model robustness. Overall, the proposed method shows significant promise for real-time, intelligent breast cancer diagnostics.

The study titled "A Bibliometric Analysis of HER2-positive Breast Cancer: 1987–2024" presents a comprehensive review of the evolution of research in this specialized field of oncology. HER2-positive breast cancer, a particularly aggressive subtype, accounts for 10–15% of all breast cancers and has historically been associated with poor prognosis. This bibliometric analysis examined 7,469 English-language publications from the Web of Science Core Collection, spanning from 1987 to 2024. The analysis identified the United States, China, and Italy as the top three contributors in terms of publication volume, with the USA also leading in citation impact and international collaboration. Key authors such as Dennis Slamon and Jose Baselga were recognized for their highly influential work, including seminal studies on trastuzumab, the first FDA-approved targeted therapy for HER2+ breast cancer. The most cited journals were Clinical Cancer Research and Breast Cancer Research and Treatment, indicating their central role in the dissemination of key findings. Evolving research themes include metastatic HER2+ treatment, resistance mechanisms, and neoadjuvant strategies.

The study titled “IoMT Cloud-Based Intelligent Prediction of Breast Cancer Stages Empowered With Deep Learning” presents a deep learning-based model for early breast cancer detection. The authors designed a two-phase system—training and validation—using convolutional neural networks (CNNs) to predict not only the presence of breast cancer but also its specific stages. By incorporating data from IoMT (Internet of Medical Things) devices like CT, MRI, and PET scans, the model processes images through noise reduction, segmentation, and classification. The model demonstrated high accuracy rates: 98.86% in training and 97.81% in validation for general detection, and up to 99.32% accuracy for stage classification. It outperformed existing state-of-the-art methods, proving its potential for real-world medical use. The model classifies cancer into four types: ductal carcinoma, lobular carcinoma, mucinous carcinoma, and papillary carcinoma, providing emergency alerts upon detecting malignancy. Statistical evaluations such as precision, recall, and F1-score support the model’s robust performance. Furthermore, the model's ability to integrate into cloud systems facilitates remote diagnostics and healthcare accessibility. This study showcases the power of AI and IoMT in transforming cancer diagnosis and improving patient outcomes.

The review paper titled “Signal Processing Techniques and Computer-Aided Detection Systems for Diagnosis of Breast Cancer” explores various computer-aided detection (CAD) systems used to enhance breast cancer diagnosis. The study emphasizes the limitations of traditional mammogram readings and highlights the advantages of digital mammography paired with CAD techniques. Among these, wavelet and curvelet transforms are featured prominently for their effectiveness in image enhancement and feature extraction. Curvelet transform achieved the highest classification accuracy at 98.59%, especially effective for identifying masses, while wavelet transform showed promise for detecting microcalcifications. Other approaches such as genetic algorithms, artificial neural networks, and fuzzy logic systems were also discussed for their roles in segmentation and classification. Although CAD systems help reduce reliance on double readings by radiologists, their recall rates still need improvement. The review suggests that better feature selection and threshold tuning could significantly enhance classification performance. Additionally, tools like MATLAB support image preprocessing and simulation of various detection algorithms.

The article titled "Breast Cancer Detection and Classification Using Deep CNN Techniques" presents a deep learning approach to improve breast cancer recognition using mammography images. The authors utilize the DDSM dataset and apply various preprocessing techniques, including Wiener filtering, CLAHE, and wavelet packet decomposition, to enhance image quality and extract relevant features. They employ deep convolutional neural networks, specifically GoogleNet and AlexNet, as well as traditional machine learning methods like PSO-MLP and ACO-MLP. The study compares these models in terms of accuracy, loss rate, and runtime using different optimizers and learning rates. GoogleNet achieved the highest accuracy of 99% with the lowest loss and runtime when using the Adam optimizer and a low learning rate. AlexNet also performed well, though slightly behind GoogleNet in overall results. PSO-MLP and ACO-MLP, which use statistical features for classification, showed lower accuracy and longer runtimes. ROC curve analysis confirmed the strong performance of the deep learning models, especially GoogleNet. The study concludes that deep CNNs, particularly GoogleNet, outperform traditional methods in breast cancer detection. This demonstrates the potential of deep learning in improving diagnostic accuracy and aiding radiologists in early cancer detection.

The article "Deep Convolutional Neural Networks for Breast Cancer Screening" explores the use of advanced deep learning techniques to assist radiologists in classifying breast cancer lesions more accurately. The researchers developed a Computer-Aided Diagnosis (CAD) system using pre-trained Convolutional Neural Networks (CNNs) such as VGG16, ResNet50, and Inception v3. These models were fine-tuned using transfer learning and trained on several public mammogram datasets like DDSM, BCDR, and INbreast. To improve performance and reduce overfitting, the team applied preprocessing steps, data augmentation, and regularization techniques like dropout and L2 penalties. The models achieved high classification accuracy, with Inception v3 performing the best—achieving 98.94% on the merged dataset and 98.23% on an independent test set (MIAS). Their approach outperformed previous methods and demonstrated that fine-tuning only the last two convolutional blocks provided the best results. A Breast Cancer Screening Framework was built around the best-performing model to provide diagnostic support to clinicians. The study showed that CNNs, when properly trained, can serve as effective second opinions in medical image analysis. Finally, the authors suggest future work should include using more challenging cases and integrating additional imaging techniques like MRI for improved diagnosis.

The article titled “A CNN-Based Methodology for Breast Cancer Diagnosis Using Thermal Images” presents a computer-aided diagnosis (CAD) system utilizing convolutional neural networks (CNNs) for breast cancer detection through thermography. The study addresses the limitations of traditional imaging techniques like mammography and proposes a low-cost, non-invasive alternative using thermal imaging. The authors used the publicly available DMR-IR database, consisting of 1,140 thermal images from 57 patients, to train and test their models. They applied data preprocessing and augmentation techniques to improve model performance and reduce overfitting. The study compared various CNN architectures and found that simpler models like SeResNet18 performed better than complex ones on this dataset. Additionally, a Bayesian optimization technique was implemented to fine-tune hyperparameters, achieving a top model with 92% accuracy and F1-score. The research demonstrated that data augmentation could compensate for limited dataset size, showing comparable results with smaller datasets. The paper also emphasizes the importance of proper dataset splitting to avoid bias and ensure robust model training. Ultimately, the study concludes that CNN-based CAD systems offer a promising and efficient tool for breast cancer screening using thermal images.

The article “Preprocessing of Breast Cancer Images to Create Datasets for Deep-CNN” presents a methodology for preparing mammographic images for deep convolutional neural networks (D-CNN). It highlights the rising incidence of breast cancer and the urgent need for accurate, efficient computer-aided diagnosis tools. The authors emphasize the importance of preprocessing to reduce computational time and improve model accuracy. They propose several preprocessing steps, including background removal using the Rolling Ball Algorithm and Huang’s Fuzzy Thresholding, which successfully cleaned 100% of the images. Pectoral muscle removal is achieved through Canny Edge Detection and the Hough Line Transform, with a 99.06% success rate. Noise is purposefully added to the images to simulate real-world data and enhance the D-CNN’s generalization. Image enhancements using Look-Up Tables (LUTs) such as Invert, CTI_RAS, and ISOCONTOUR further help highlight regions of interest (ROIs). The processed images are validated using metrics like PSNR, SSIM, and Dice Coefficient, showing minimal quality loss and high structural similarity. The study concludes that these preprocessing methods can create effective training datasets, improving the performance of D-CNNs in real-world diagnostic scenarios. This approach contributes to the development of reliable and accessible diagnostic tools for breast cancer detection.

The article titled "SD-CNN: a Shallow-Deep CNN for Improved Breast Cancer Diagnosis" proposes a novel method for breast cancer diagnosis using deep learning. It introduces the Shallow-Deep Convolutional Neural Network (SD-CNN), which integrates a shallow CNN to generate “virtual” recombined images from full-field digital mammography (FFDM) and a deep CNN to extract features for classification. The method is motivated by the diagnostic benefits of contrast-enhanced digital mammography (CEDM), which offers better sensitivity than FFDM, especially in women with dense breasts. Since CEDM is not widely available, the authors propose using SD-CNN to emulate CEDM’s advantages through synthetic imaging. They tested their approach using 49 real CEDM cases and 89 public FFDM cases from the INbreast dataset. Results show that adding recombined or virtual recombined images significantly improves diagnostic accuracy and specificity. The model achieved an AUC of 0.91 with true recombined images and 0.92 with virtual ones, outperforming many state-of-the-art methods. The authors highlight the importance of image preprocessing and feature extraction from tumor regions for model performance. Additionally, their method helps reduce false positives, which is a common issue in breast cancer screening. The study concludes that SD-CNN is a promising tool to enhance diagnostic accuracy where access to advanced imaging modalities is limited.

The article titled “Efficient Ultra Wideband Radar Based Non-Invasive Early Breast Cancer Detection” introduces a novel system using Ultra Wideband (UWB) radar for early breast tumor detection. The researchers propose a pulse shaping technique using a seventh derivative Gaussian pulse shaped by a sharp transition bandpass FIR filter to improve spectral efficiency and minimize interference. This shaped pulse is transmitted via Vivaldi antennas in both monostatic and bistatic radar setups, penetrating the breast tissue and detecting tumors based on variations in backscattered signals and electric field intensities. The system’s efficiency is validated through simulations and experiments using a fabricated heterogeneous breast phantom, which mimics real breast tissue properties. Specific Absorption Rate (SAR) analysis is employed to locate tumors by measuring areas of high energy absorption. Results show that the shaped pulse enhances antenna radiation efficiency and detection sensitivity for tumors as small as 0.5 mm. The proposed method complies with FCC safety standards and shows high spatial resolution with lower power consumption. Additionally, the study explores how pulse shaping improves detection accuracy, especially for deeply located tumors. The research concludes that UWB radar with shaped pulses is a promising tool for early, non-invasive breast cancer detection. Future work includes adapting the system to account for patient variability and improving tumor classification accuracy.

The article titled "Enhancing Breast Cancer Diagnosis with Bidirectional Recurrent Neural Networks: A Novel Approach for Histopathological Image Multi-Classification" presents a deep learning model that improves breast cancer diagnosis by accurately classifying histopathological images. The proposed model integrates a Bidirectional Recurrent Neural Network (BRNN) architecture, which combines a ResNet50-based CNN for feature extraction, a Gated Recurrent Unit (GRU) for sequential data handling, and a residual collaborative branch for enhanced pathological feature detection. An attention mechanism is also used to focus on significant image regions, while the Adagrad optimizer fine-tunes the model’s performance. The system was tested on the BreaKHis dataset, which includes 7,909 images across eight breast cancer subtypes and achieved an impressive classification accuracy of 97.25%. This model outperformed previous state-of-the-art methods, demonstrating its robustness across multiple magnification levels (40x to 400x). The study also emphasized the importance of combining temporal and spatial data analysis for reliable diagnosis. By leveraging pre-trained networks and sophisticated feature fusion, the BRNN system significantly enhances medical image classification. Ultimately, this approach aims to support oncologists with faster, more precise diagnostic tools and has the potential to be expanded to other medical imaging applications.

In the survey titled "Breast Cancer Type Classification Using Machine Learning" by Jiande Wu and Chindo Hicks, the study delves into the application of machine learning algorithms to improve the classification of breast cancer types using clinical diagnostic data. Conducted at the Department of Genetics, School of Medicine, Louisiana State University Health Sciences Center, this research emphasizes the importance of early detection—a vision shared by our AI-based platform, DETECT HER. The study leverages supervised learning methods, including Support Vector Machines (SVM), Random Forest, Logistic Regression, and K-Nearest Neighbors (KNN), to differentiate between benign and malignant tumors. Using the Wisconsin Breast Cancer Dataset, the research highlights how data preprocessing, such as normalization and feature selection, significantly enhances model performance. Accuracy, precision, recall, and F1-score were employed as evaluation metrics, with SVM and Random Forest achieving superior results. These findings reinforce the value of artificial intelligence in supporting diagnostic decision-making. Wu and Hicks' methodology complements DETECT HER’s hybrid approach, which combines CNN-based mammogram image classification with a symptom-driven staging module. Both initiatives aim to reduce diagnostic error, increase accessibility, and streamline clinical workflows, especially in resource-constrained healthcare settings. This alignment reflects a broader trend in medical innovation, where AI is increasingly integrated into frontline diagnostic tools to enhance early detection and improve patient outcomes.

In the survey titled "An Early Breast Cancer Detection by Using Wearable Flexible Sensors and Artificial Intelligent", authored by Dalia N. Elsheakh, Omar M. Fahmy, Mina Farouk, Khaled Ezzat, and Angie R. Eldamak, the study introduces an innovative approach that integrates wearable flexible sensors with artificial intelligence for the early detection of breast cancer. The research focuses on a non-invasive, real-time health monitoring system that collects critical physiological data, such as temperature variations and tissue anomalies, through smart wearable devices. This data is processed using machine learning algorithms to detect early signs of malignancy with high accuracy and efficiency. The study highlights how combining sensor technology with AI not only enhances diagnostic precision but also minimizes the risk of false positives and delays in detection. The wearable design emphasizes patient comfort and continuous monitoring, offering a scalable solution for regions with limited access to traditional diagnostic tools. This system provides a cost-effective, accessible, and intelligent alternative to conventional imaging methods, aiming to improve early diagnosis and patient outcomes. The research aligns closely with the core vision of AI-powered healthcare tools like DETECT HER, reinforcing the vital role of technology in transforming preventive medicine and supporting clinical decision-making processes. By bringing together smart sensing and artificial intelligence, the study lays the groundwork for a new generation of personalized, AI-driven healthcare systems designed to fight breast cancer through timely intervention.

The survey titled "Deep Learning Assisted Efficient AdaBoost Algorithm for Breast Cancer Detection and Early Diagnosis" by Jing Zheng, Denan Lin, Zhongjun Gao, Shuang Wang, Mingjie He, and Jipeng Fan introduces a hybrid diagnostic model combining deep learning with an optimized AdaBoost algorithm. The study aims to enhance the early detection of breast cancer by using CNNs for deep feature extraction and AdaBoost for robust classification of mammographic images. This integration significantly improves diagnostic accuracy and reduces false positives compared to traditional methods. The model is tested on medical datasets and demonstrates strong performance in distinguishing between benign and malignant tumors. The authors emphasize the system's efficiency, scalability, and potential for clinical use, particularly in areas with limited radiology resources. Their findings suggest that AI-driven solutions can greatly support medical professionals in delivering timely and precise breast cancer diagnoses.

The research article titled "Enhancing Lung Cancer Detection with Deep Learning: A CT Image Classification Approach", authored by Jeevika K S and Dr. Savitha S K, presents an advanced deep learning methodology to enhance the detection of lung cancer through CT image classification. The study addresses the urgent need for accurate and early diagnosis of lung cancer, which remains a leading cause of cancer-related mortality. Utilizing Convolutional Neural Networks (CNNs), the authors propose a model capable of differentiating between benign and malignant nodules with improved precision. Their approach includes meticulous image preprocessing techniques such as resizing, normalization, and augmentation to ensure data quality and robustness. The model is trained on a labeled dataset of CT images, achieving high accuracy and reducing false positives. The system is designed to assist radiologists by automating the diagnostic process and minimizing human error. Furthermore, the study highlights the model's efficiency in terms of speed and performance, making it a viable solution for real-time applications. The integration of this AI-based solution into clinical workflows could significantly improve patient outcomes through timely intervention. Overall, the paper demonstrates how deep learning can revolutionize cancer diagnostics by delivering scalable, reliable, and accessible tools for medical professionals.

The survey report titled "A Hybrid Dependable Deep Feature Extraction and Ensemble-Based Machine Learning Approach for Breast Cancer Detection" is authored by Selina Sharmin, Tanvir Ahammad, Md. Alamin Talukder, and Partho Ghose. This study introduces a hybrid model that merges deep learning with ensemble-based machine learning to improve breast cancer detection. It employs Convolutional Neural Networks (CNNs) for deep feature extraction from mammogram images. The extracted features are processed using ensemble classifiers such as Random Forest and XGBoost. The authors highlight the importance of reliable automated diagnostic systems in supporting healthcare professionals. Public datasets like the Wisconsin Breast Cancer Diagnostic Dataset (WBCD) are used for model training and evaluation. The proposed model achieved high accuracy, sensitivity, and specificity. It outperformed several existing state-of-the-art diagnostic methods. The ensemble approach reduces overfitting and ensures prediction stability. Overall, the study offers a significant contribution to computer-aided diagnosis in breast cancer.

The survey report titled "Breast Cancer Diagnosis Prediction using Convolutional Neural Network Algorithm" was authored by Basem S. Abunasser, Mohammed Rasheed J. AL-Hiealy, Ihab S. Zaqout, and Samy S. Abu-Naser. This research presents an analytical review of the role of Convolutional Neural Networks (CNNs) in enhancing breast cancer prediction accuracy. The study explores CNN-based models and their capacity to analyze medical imaging data, aiming to assist clinicians in early and accurate diagnosis. The authors emphasize the critical importance of early detection, which significantly improves the chances of successful treatment and survival. In this context, CNNs offer a powerful approach by automating the feature extraction process and reducing the need for manual intervention. The survey also discusses various datasets commonly used in breast cancer prediction, highlighting how image quality and preprocessing influence model performance. A detailed evaluation of model accuracy, precision, and recall metrics is included to assess the effectiveness of CNN architectures. Furthermore, the study provides insights into the strengths and limitations of existing CNN models and suggests directions for future research. By comparing different CNN-based methods, the authors conclude that deep learning techniques hold great promise in medical image classification and cancer detection. Overall, this survey contributes to the growing body of knowledge advocating for the integration of AI in clinical diagnostic workflows.

The survey titled "Breast Tumor Detection Using Empirical Mode Decomposition Features" by Hongchao Song, Aidong Men, and Zhuqing Jiang explores a unique approach for detecting breast tumors using ultrasound images. The authors apply Empirical Mode Decomposition (EMD) to extract meaningful features from complex medical signals. This method effectively handles the non-linear and non-stationary nature of ultrasound data. A Support Vector Machine (SVM) classifier is used to distinguish between benign and malignant tumors. The results show that EMD-based features outperform traditional texture-based techniques in accuracy and efficiency. The system also incorporates adaptive filtering to reduce image noise and improve clarity. Feature selection techniques are applied to enhance performance while reducing computational cost. The method demonstrates strong potential for real-world diagnostic use in computer-aided detection systems. It supports radiologists in making faster and more reliable decisions. The study confirms EMD's viability as a robust tool for early breast cancer detection.

The survey titled "An Automatic Detection of Breast Cancer Diagnosis and Prognosis Based on Machine Learning Using Ensemble of Classifiers" by Usman Naseem, Junaid Rashid, Liaqat Ali, Jungeun Kim, Qazi Emad Ul Haq, Mazhar Javed Awan, and Muhammad Imran presents a machine learning approach to breast cancer diagnosis. The authors emphasize the need for automated systems to reduce diagnostic errors and enhance early detection. They propose an ensemble of classifiers, including Decision Trees, SVM, and KNN, to improve accuracy and robustness. The model is tested on the WBCD and WBCP datasets. Results show improved performance compared to single classifiers. Feature selection and preprocessing were essential to optimize the system. The ensemble approach enhances generalization and reduces false positives. The study underlines the importance of integrating AI in medical diagnostics. The proposed system supports clinicians with faster, more accurate decisions. Overall, the research highlights the potential of hybrid machine learning for breast cancer prognosis.

## 3. CONCLUSIONS

The DETECT HER project exemplifies the transformative potential of artificial intelligence in healthcare, specifically in the early detection and assessment of breast cancer. By integrating deep learning-based image classification with a symptom-driven staging assessment, the platform offers a dual-path diagnostic tool accessible to both individuals with mammographic data and those relying on symptom analysis. The system's core features—powered by Convolutional Neural Networks and deployed via a robust Flask-based web architecture—demonstrate not only technical efficiency but also clinical relevance, achieving a commendable prediction accuracy of approximately 80% and delivering rapid results even on modest computational setups.This AI-assisted solution bridges a critical gap in regions where access to radiologists and advanced diagnostic infrastructure is limited. It empowers users and healthcare professionals alike by providing a fast, cost-effective, and user-friendly tool for preliminary breast cancer detection. The seamless interaction between frontend and backend components ensures an intuitive experience, making DETECT HER a practical asset in real-world clinical and non-clinical environments.Looking forward, the system holds vast potential for further enhancement. Future developments may include scaling the dataset to improve accuracy and generalization, migrating the model to cloud infrastructure for real-time global accessibility, and integrating expert medical consultation features to reinforce diagnostic confidence. Additionally, enriching the platform with multi-modal data—such as genetic markers, lifestyle factors, and clinical history—could enable a more holistic risk assessment framework. .In conclusion, DETECT HER represents a significant stride toward inclusive, AI-powered diagnostic support. By harnessing modern technologies in service of early detection and informed decision-making, this platform can play a pivotal role in improving survival outcomes and advancing the future of AI-integrated healthcare.

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