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Breast Cancer Detection System Using Machine Learning

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Abstract

AI is transforming the medical field, especially in the early detection and categorization of breast cancer. Deep learning models such as CNNI-BCC have shown remarkable accuracy in analyzing MRI scans to identify various types of breast cancer. This advancement in technology has significant implications for enhancing patient outcomes.
By utilizing AI, healthcare professionals can now receive more accurate. The high accuracy of CNNI-BCC in interpreting MRI scans supports the early detection of breast cancer, which plays a vital role in improving treatment outcomes. By highlighting abnormalities that might be overlooked by conventional techniques, this technology helps clinicians make more timely and effective decisions.

INTRODUCTION

Cancer impacts individuals from all walks of life and is a prevalent global health issue. While there are numerous types of cancer, breast cancer stands out as one of the most widespread forms of cancer in women. It originates from breast cells and is a common malignancy among females worldwide, ranking second only to lung cancer as a leading cause of death in women. Factors that increase the risk of developing breast cancer include genetics, family history, hormonal influences such as reproductive history, and age and gender, with older age and female gender being contributing factors.

LITERATURE SURVEY

The Detection of Breast cancer through analyzing radiographic images using machine learning. This study observed many advantages of using ML in the Healthcare Sector, by Ayala, Kristell Yukie Jimenez, (2024).[1], The Biogenic Nanoparticles: pioneering a new era in Breast Cancer therapeutics- a comprehensive review. This conventional treatment like surgery, radiotherapy, and chemotherapy face limitations such as low efficiency and adverse effects. Thus it underscores the potential of Plant-Mediated synthesis of biogenic NPs as their effective therapies for breast cancer in 2024 by Bhat, Shahnawaz Ahmad; Kumar, Vijay; Dhanjal, Daljeet Singh; Gandhi Yashika; Mishra, Sujeet K; Singh, Simranjeet; Webster, ThomasJ; Ramamurthy, Praveen.[2], The Advanced hyperthermia treatment: optimizing microwave energy focuses on breast cancer therapy. This study introduces a rapid antenna phase optimization method to enhance microwave power concentration for hyperthermia treatment of breast cancer. In 2024, ACAR, Burak; YILMAZ, Tuba; and YAPAR, Ali validated this method using a circular applicator equipped with eight TMz-polarized line sources that position around realistic digital breast phantoms." [3], Exploring the Anti-Breast Cancer potential of Chalcomoracin, Guangsangon E and Morushalunin: A computational analysis of compounds from Morus sp. This study aimed to analyze the interaction between proteins as well as determine the physicochemical and pharmacological properties of these compounds. These concluded that the compounds could effectively interact with PD-1 and PRAR-gamma, two important proteins in breast cancer in 2023 by Hakim, Rani Wardani; Putri, Rizky Clarinta; Fachri, Rizki; Hakim, Euis Holisotan; Wulansari, Dewi.[4], Targeting triple-negative breast cancer stem cells using nanocarriers. Tumor initiation and treatment resistance in TNC are attributed to breast cancer stem cells, which possess self-renewal, differentiation, and tumorigenic potential. These nanoparticles-based by delivering targeted therapies to BCSCs while minimizing systemic toxicity and enhancing treatment efficiency in 2024 by Dasari, Nagasen; Guntuku, Girija Sankar; Pindiprolu, Sai Kiran S. S.[5].

METHODOLOGY

In this study, a Convolutional Neural Network (CNN) model was developed to classify breast tumors as either benign or malignant. CNNs, known for their efficiency in image analysis, were selected for their ability to identify complex patterns and spatial relationships of data. The input dataset was preprocessed through normalization and reshaping to match the expected input dimensions of the CNN. The model architecture included several convolutional layers activated by ReLU functions, along with max-pooling layers to reduce feature map dimensions while preserving essential information. Fully connected dense layers followed, forming the decision-making part of the network. To improve generalization and mitigate overfitting, dropout layers have been integrated. The model was created utilizing the Adam optimizer along with categorical cross-entropy as the loss function. The evaluation was conducted using standard performance metrics, including accuracy, precision, recall, F1-score, and analysis of the confusion matrix. The CNN demonstrated robust predictive capabilities and highlighted its potential as a valuable tool in computer-aided breast cancer diagnosis.

EXPERIMENTAL RESULTS

These figures show the results for detecting Breast cancer and the accuracy rate of the CNN model from greyscale mammographic images using the ML model.

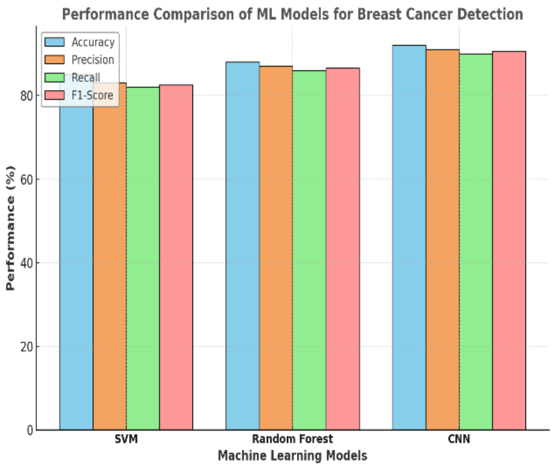

Fig 1. Comparison of SVM, Random forest, and CNN models of ML

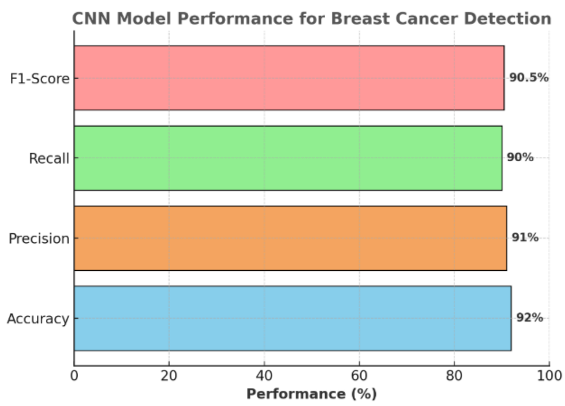

Fig 2. A high Accuracy rate was observed by the CNN model among the rest

Fig 3. Normal Breast detected with no cancer using mammographic image (greyscale)

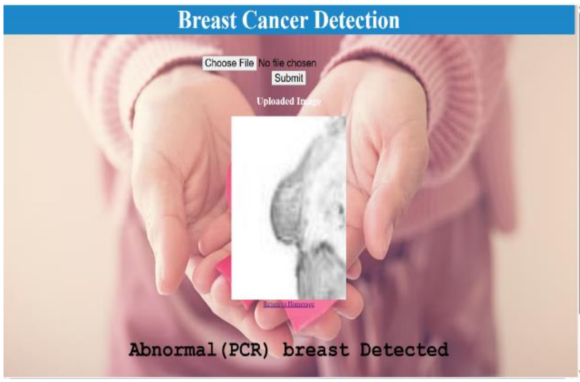

Fig *4. Breast cancer detected using mammographic image (greyscale)*

CONCLUSION

This study focuses on implementing various machine learning models, including linear Support Vector Classification (SVC), Support Vector Classifier (SVC), K-Nearest Neighbors (KNN), Decision Tree (DT), Random Forest (RF), and Logistic Regression (LR), to predict breast cancer classification. The data was preprocessed using the Standard Scaler for normalization, and the performance of each model was evaluated based on accuracy, AUC, recall, sensitivity, and F1-score. Among all the models, Random Forest demonstrated the highest accuracy, followed by Decision Tree and KNN. The Random Forest model proved particularly effective due to its adaptability and ability to pinpoint key features crucial for classification. Early breast cancer detection, primarily using techniques such as mammography and breast MRI, is vital for successful treatment. Integration of machine learning with these imaging methods can significantly improve detection accuracy while minimizing human error. Future studies should focus on further enhancing AI models for better detection and diagnosis of breast cancer through advanced imaging techniques.

References

1. Ayala, K. Y. J. (2024)A comprehensive review on breast cancer detection using machine learning techniques applied to radiographic imaging.
2. Bhat, S. A., Kumar, V., Dhanjal, D. S., Gandhi, Y., Mishra, S. K., Singh, S., Webster, T. J., & Ramamurthy, P. C. (2024). Biologically synthesized nanoparticles: Recent advances and potential biomedical applications.
3. ACAR, Burak; YILMAZ, Tuba; YAPAR, Ali (2024) – "Advanced hyperthermia treatment: optimizing microwave vitality center for breast cancer therapy"
4. Hakim, Rani Wardani; ,Putri, Rizky Clarinta; Fachri, Wilzar; Fadilah, Fadilah; Krisnamurti, Desak Gede Budi; Fitriani, Rizki; ,Hakim, Euis Holisotan; Wulansari, Dewi (2023) – "Computational Analysis of Chalcomoracin, Guangsangon E, and Morushalunin: Investigating Bioactive Compounds Derived from Morus Species."
5. Dasari, N., Guntuku, G. S., & Pindiprolu, S. K. S. (2024) –"Targeting Triple-negative breast cancer stem cells using Nanocarriers.