

## **APPLYING DEEP LEARNING FOR BREAST CANCER DETECTION USING RADIOLOGY**

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**Abstract:** Breast cancer remains a critical health challenge across the globe ,where timely identification significantly influences treatment success and survival rates. Traditional diagnostics tools such as mammography, ultrasound imaging, and magnetic resonance imaging(MRI)rely heavily on specialist interpretation, which may introduce inconsistencies, particularly in cases involving dense or complex tissue structures. Recent progress in artificial intelligence has enabled more dependable analysis through data driven models. In this study, a deep learning framework is developed to identify breast cancer from medical image using convolutional neural network (CNN)integrated with a pre-trained Resnet-50 backbone. Prior to model processing, images are refined through denoising, normalization ,and dimensional standardization .The Resnet-50 network is used to derive meaningful visual patterns, which are then passed through classification layers to determine whether a tumor is benign or malignant. To make the predictions more interpretable, Grad-CAM is employed to visually indicate influential regions within the images. The System is built using Python with Tensor flow and Keras, and is connected to a web interface that allows users to upload images and receive automated diagnostics summaries. The observed outcomes indicate strong predictive capability, suggesting that such systems can support clinical workflows by reducing manual effort and aiding early stage detection

**Keywords:** Deeplearning,CNN,RES-Net50,Breastcancer detection, Medical Imaging

## **I. INTRODUCTION**

All Breast cancer is widely recognized as one of the most frequently occurring cancer, resulting from uncontrolled cell growth within breast tissue. detecting the disease at an early stage plays a vital role in improving patient prognosis and expanding treatment options. Screening methods such as mammograms are commonly used, however their effectiveness may vary depending on factors like tissues density and interpretation variability among clinicians.[1] Advances in computing and the availability of medical imaging datasets have encouraged the use of deep learning in Earlier research in breast cancer detection primarily relied on handcrafted features such as texture, shape, and statistical descriptors combined with machine learning algorithms like Random Forest and support vector machines. While these approaches achieved moderate performance, they were limited by dependency on manual feature extraction and reduced interpretability [3].

Various image processing techniques, including edge detection methods such as Canny and Holistically nested Edge detection, have been applied to improve feature extraction and reduce noise in medical images. Additionally , breast phantom studies have been used to simulate real tissue characteristics for improved analysis and validation [4].

Machine Learning techniques have contributed significantly to disease prediction by improving classification performance and efficiency [5] Emerging technologies such as rapid diagnostic kits and microwave imaging also show potential, although further research is required for real-world implementation [6] [7].

In recent years, deep learning models, particularly Convolutional Neural Networks (CNNs), have shown superior performance in medical image analysis. These models automatically learn relevant features and achieve higher accuracy compared to traditional methods. The standards pipeline includes preprocessing, feature extraction, and classification, making deep learning a powerful approach for breast cancer detection [11], [12].

## **II. METHODOLOGY**

The proposed breast cancer detection system utilizes a deep learning based approach to examine medical images and identify different types of breast lesions. The methodology follows a structured pipelined that includes data collection ,image preprocessing ,model construction, classification and interpretation of results.

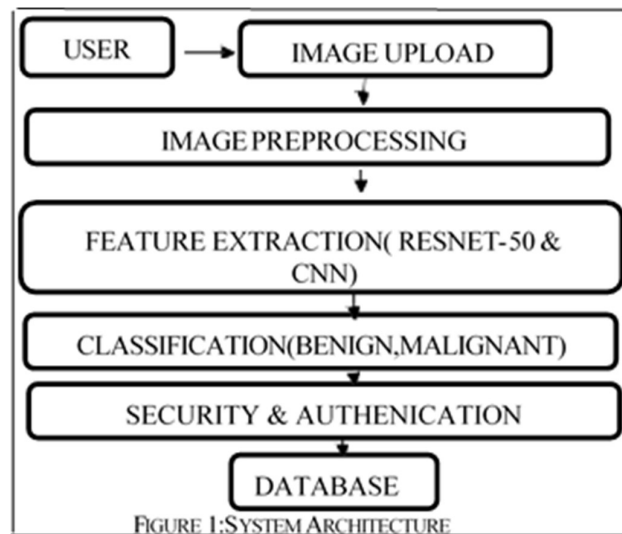
In the initial phase, medical image datasets are gathered from publicly accessible repositories, including modalities such as mammography, ultrasound, and magnetic resonance imaging(MRI).These datasets consists of annotated samples classified into categories such as normal ,benign and malignant. The preprocessing phase focuses on improving the quality and uniformity of the input images before they are used for training. This involving applying techniques such as noise filtering, scaling pixel intensity values, resizing images to a consistent dimension and enhancing contrast. These operations help stabilize the learning process and contribute to better model generation.

At the core of the system is a Convolutional Neural Network (CNN) build upon pre-trained ResNet-50 architecture, by applying transfer learning the model reuses previously visual learned features, reducing computational cost and improving learning accuracy. Additional fully connected layers are incorporated to fine-tune the model for the specific task of breast cancer detection. The final

model performs multi-category classification, to categorize image as normal, benign, or malignant.

To improve interpretability, grad-CAM (Gradient-weighted class activation Mapping) is used to highlight the regions in the image that significantly influence the models predictions. This enhances transparency and supports clinical decision-making.

The performance of the model is evaluated using standard metrics such as accuracy, precision, recall, and F1 score. The system is implemented using Python with TensorFlow and Keras frameworks and is integrated with a user-friendly interface for image upload, predictions, and report generation. The overall workflow of the proposed system is illustrated in figure 1.



#### IV EASE OF USE

##### A. System Usability

The developed breast cancer detection system is intended to offer a smooth and practical experience for healthcare practitioners. Its features a simple interface through which users can submit medical images, including mammograms and histopathology samples, without difficulty. Once the data is uploaded ,Once the data is uploaded ,the system independently performs the required analysis and generate predictions indicating the likelihood of cancer

##### B. Reliabilityand Performance

Training on extensive medical image datasets enables the model to produce consistent and trustworthy predictions. Additionally ,the system is optimized to deliver results.

##### C. Abbreviations and Acronyms

Each abbreviation or acronym is introduced with its full form when it first appears in the document. Frequently used terms in this study include Artificial Intelligence(AI), Machine Learning(ML), and Convolutional Neural Network(CNNs),all of which play a key role in implementing deep learning techniques for breast cancer identification.

#### D. Equations

Mathematical expressions are incorporated to assess the effectiveness of the proposed deep learning model. All formulas are presented using standard notations and are organized in a sequential manner.

Accuracy measures the overall correctness of the model:

$$\text{Accuracy} = \frac{(TP + TN)}{(TP + TN + FP + FN)}$$

Precision measures how many predicted positive cases are correct:

$$\text{Precision} = \frac{TP}{(TP + FP)}$$

Recall (Sensitivity) measures how well the model identifies actual positive cases:

$$\text{Recall} = \frac{TP}{(TP + FN)}$$

F1-Score is the harmonic mean of precision and recall: F1-

$$\text{Score} = \frac{(2 * TP)}{(2 * TP + FP + FN)}$$

Where:

TP = True Positive TN=True Negative FP=False Positive FN=False Negative

#### V. RESULTS AND DISCUSSIONS

The developed breast cancer system, built using convolutional Neural Networks (CNN) was implemented and tested with histopathology images data. It provides a complete processing pipeline, covering all stages from image submission to the creation of a diagnostics report.

Users can input medical images along with essential patient information such as name, age, and contact details. After submission, the image is refined through preprocessing steps and then evaluated by the trained CNN model. The model identifies relevant patterns and categorizes the tumor as either benign or malignant based on learned features.

During testing, the system demonstrated strong capability by identifying a histopathology sample as malignant with a confidence level 99.94%. It also indicated an advanced cancer stage (Stage IV) and issued a prompt advising immediate medical attention. A comprehensive report was automatically produced, including patient details, classification outcomes, confidence level, identified stage, and recommended precautions, which was then exported in PDF format.

This high level of accuracy highlights the capability of CNN-based approaches to interpret complex medical image patterns effectively. Incorporating patient information alongside prediction results improves the practical value of the system, while automated report generation minimizes manual work and ensures uniformity in output.

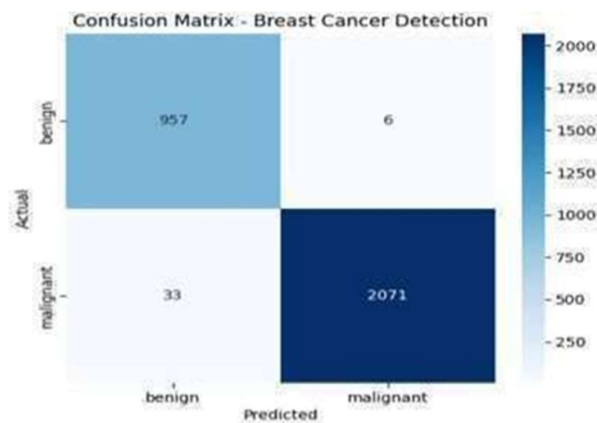


Fig. 1 illustrates the confusion matrix of the proposed model, showing strong classification performance with minimal misclassification.

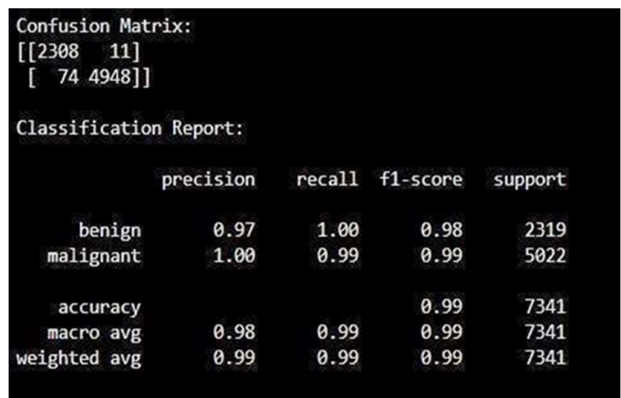


Fig .3:Presents the classification report, including precision, recall and f1-score ,further validating the model’s performance.

VI. TABLESAND FIGURES

|                   |                      |                        |                                                      |
|-------------------|----------------------|------------------------|------------------------------------------------------|
| Aspect            | Previ<br>ous<br>Work | Propos<br>ed<br>System | improvement                                          |
| Mod<br>el<br>used | Basic<br>CNN         | Resnet-<br>50+CN<br>N  | Higher<br>accuracy &<br>better feature<br>extraction |
| Accu<br>racy      | 92%                  | 98.92%                 | Improving<br>prediction<br>accuracy                  |

|                   |                |                          |                                    |
|-------------------|----------------|--------------------------|------------------------------------|
| Preprocessing     | Basic resizing | Resizing + normalization | Better image quality & consistency |
| Report generation | Manual/limited | Automated reports        | Faster and standardized reporting  |

User interface Less interactive      User-friendly interface      Easier medical professionals

## VII .CONCLUSION

The proposed breast cancer detection system demonstrates the effectiveness of deep learning techniques in medical image analysis for accurate diagnosis. By Utilizing a Convolutional Neural Network (CNN) with a ResNet-50 architecture, the system efficiently extracts meaningful features from radiological images and accurately classifies them as benign or malignant.

The system automates key processes such as image preprocessing, feature extraction, classification, visualization, and report generation, thereby reducing dependency on manual analysis. It functions as an AI-assisted decision support tool for radiologists by improving diagnostic consistency, minimizing inter-observer variability, and reducing diagnosis time. Furthermore, the system ensures data security and privacy, making it suitable for deployment in clinical environments.

Overall, the proposed approach enhances early detection capabilities and improves diagnostic confidence. It has strong potential for real-world application in hospitals and diagnostic centers, especially in regions with limited access to expert radiologists, thereby contributing to improved healthcare outcomes and reduced mortality rates.

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