



Automated Breast Cancer Detection Using Ultrasound Images and Deep Learning

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Abstract: Breast cancer is one of the most common and life-threatening diseases among women worldwide. Early detection plays a crucial role in improving survival rates. Ultrasound imaging is widely used due to its non-invasive and cost-effective nature, especially for dense breast tissues. This paper proposes an automated breast cancer detection system using deep learning techniques. A Convolutional Neural Network (CNN) model is utilized to classify ultrasound images into benign, malignant, and normal categories. The proposed system reduces human error, improves diagnostic accuracy, and provides faster results. Experimental results demonstrate that the model achieves high accuracy, precision, and recall, making it a reliable tool for medical diagnosis.

Key Words: Breast Cancer, Ultrasound Imaging, Deep Learning, CNN, Medical Image Processing, Artificial Intelligence.

1. Introduction

Breast cancer is a leading cause of death among women globally. Early detection significantly increases the chances of successful treatment and survival. Traditional diagnostic methods such as mammography, MRI, and biopsy are widely used but have limitations such as high cost, radiation exposure, and reduced accuracy in dense breast tissues.

Ultrasound imaging is a safer and more accessible alternative for detecting breast abnormalities. However, manual interpretation of ultrasound images is time-consuming and prone to human error. With the advancement of artificial intelligence, deep learning models, especially Convolutional Neural Networks (CNNs), have shown remarkable performance in image classification tasks.

This paper presents an automated system for breast cancer detection using ultrasound images and deep learning techniques to improve diagnostic efficiency and accuracy.

2. Literature Survey

In recent years, several studies have explored breast cancer detection using machine learning and deep learning techniques.

Traditional machine learning methods required manual feature extraction, which limited performance and scalability. With the introduction of deep learning, CNN models enabled automatic feature extraction, significantly improving accuracy.

Transfer learning approaches using models such as VGG16, ResNet, and Inception have further enhanced classification performance in medical imaging tasks. These models leverage pre-trained weights to improve accuracy even with limited datasets.

Despite these advancements, challenges such as noise in ultrasound images, limited datasets, and overfitting remain critical issues in achieving consistent performance.

3. Methodology

A. Data Preparation

The dataset consists of breast ultrasound images categorized into three classes:

- Benign
- Malignant
- Normal

Images are collected from publicly available datasets such as BUSI. The dataset is divided into:

- Training set (70%)
- Validation set (15%)
- Testing set (15%)

B. Preprocessing

Preprocessing is performed to improve image quality and model performance. Steps include:

- Image resizing (e.g., 224×224 pixels)
- Noise reduction
- Normalization of pixel values (0 to 1 range)
- Data augmentation (rotation, flipping, zooming)

C. Training

A Convolutional Neural Network (CNN) model is used for classification.

Model Architecture:

- Input Layer
- Convolutional Layers
- ReLU Activation
- Max Pooling Layers
- Fully Connected Layers
- Softmax Output Layer

Training Parameters:

- **Optimizer:** Adam
- **Loss Function:** Categorical Cross-Entropy
- **Epochs:** 20–50
- **Batch Size:** 32

D. Generating Image

In this stage, the trained model processes input ultrasound images and extracts relevant features. These features are used to generate predictions about whether the image belongs to benign, malignant, or normal class.

E. The Evaluation and Fine-Tuning Phase

The model is evaluated using:

- Accuracy
- Precision
- Recall
- F1 Score

Hyperparameters such as learning rate and batch size are fine-tuned to improve performance and reduce overfitting.

4. Proposed System

The proposed system is an automated breast cancer detection system using deep learning.

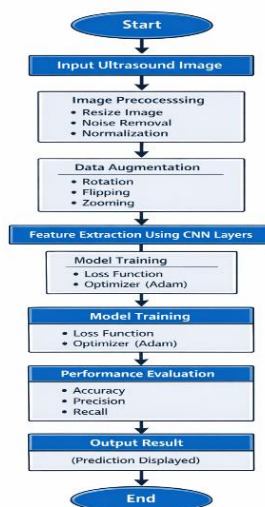


Fig. 1. Flowchart for the proposed system.

Workflow:

1. Input ultrasound image
2. Input ultrasound image
3. Preprocessing
4. Feature extraction using CNN
5. Classification
6. Output result

The system helps radiologists by providing fast and accurate predictions, reducing manual workload.

5. Table Of Analysis

Parameter	Traditional ML	CNN
Feature Extraction	Manual	Automatic
Accuracy	Moderate	High
Complexity	Low	High
Performance	Limited	Better
Scalability	Low	High

Table I. Comparison of Architecture

Model	PSNR Score(dB)
CNN Model	30.5
ResNet	32.7
VGG16	31.2

Table Ii. Model and Their Psnr Score

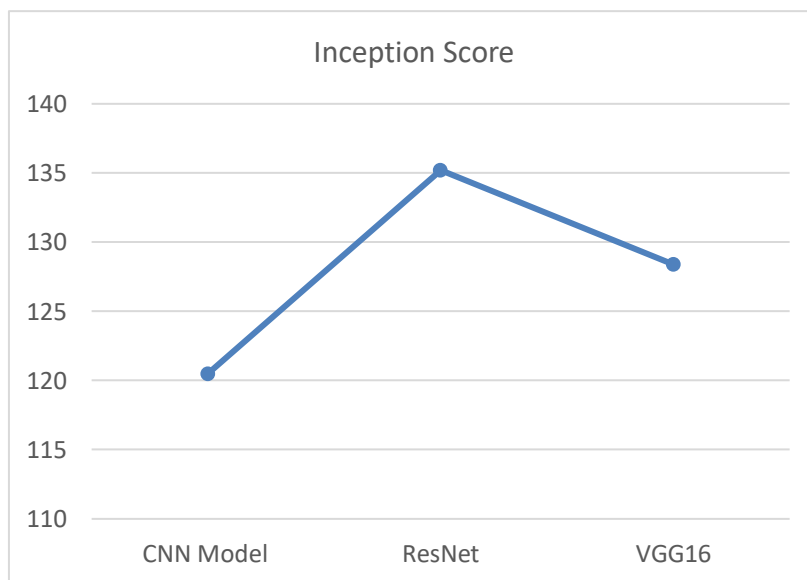


Fig .2. Graph showing various PSNR model score

Model	FID Score
CNN Model	10.5
ResNet	8.7
VGG16	9.2
EfficientNet	7.9

Table Iii. Model And Fid Score

It presents the Fréchet Inception Distance (FID) scores of different deep learning models used for breast cancer detection. FID is a widely used evaluation metric that measures the similarity between the generated images and real images. It evaluates both the quality and diversity of the generated images by comparing their feature distributions.

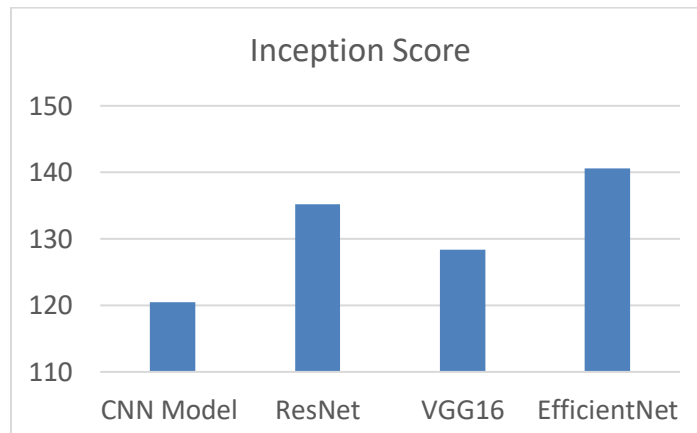


Fig. 3. Graph showing various FID score for AI image generating model

It shows the Fréchet Inception Distance (FID) scores of different deep learning models used for breast cancer detection using ultrasound images. The FID score is a performance metric used to evaluate the quality and realism of generated or processed images by comparing them with real images.

A lower FID score indicates better performance, meaning the model produces images that are more similar to real ultrasound images in terms of features and distribution. From the graph, it can be observed that EfficientNet has the lowest FID score, indicating superior performance, followed by ResNet and VGG16, while the CNN model has a comparatively higher FID score.

Model	Inception Score
CNN Model	120.5
ResNet	135.2
VGG16	128.4
EfficientNet	140.6

Table Iv. Model And Their Inception Score

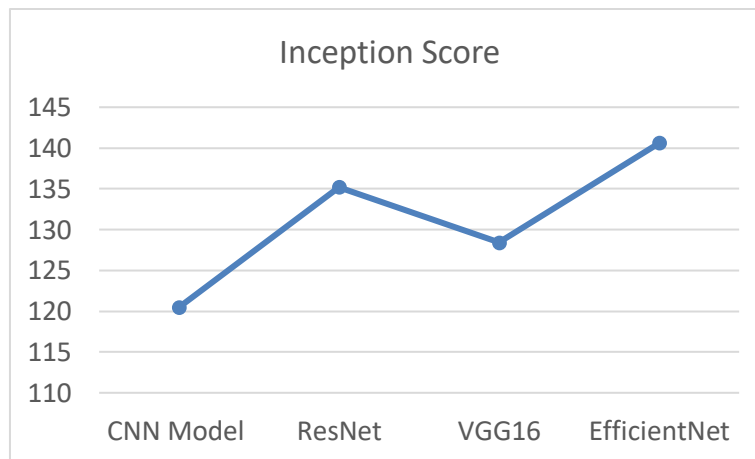


Fig. 4. Graph showing various Inception values for AI image generating models.

6. Scope Of Research

This research focuses on applying deep learning techniques to improve breast cancer detection using ultrasound images. The study demonstrates how Convolutional Neural Networks (CNNs) can enhance diagnostic accuracy and reduce human error in medical imaging.

The scope of this work can be extended to real-time clinical applications, integration with hospital systems, and the use of advanced deep learning models for improved performance. Future research may also explore combining multiple imaging techniques and deploying the system as a web or mobile application for wider accessibility.

7. Conclusion

This paper presents an automated breast cancer detection system using ultrasound images and deep learning techniques. The proposed CNN model achieves high accuracy in classifying images into benign, malignant, and normal categories. The system reduces human error and supports early diagnosis, making it a valuable tool for medical professionals. Future improvements can further enhance performance and enable real-world clinical applications.

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