# AI-Based Histopathological Image Classification for Early Detection of Breast Cancer

Ashish Parab
*Sonopant Dandekar Shikshan Mandali*

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## I. BACKGROUND

Breast cancer is one of the leading causes of cancer-related mortality among women worldwide. The accuracy and speed of diagnosis play a crucial role in improving patient survival rates. Traditional histopathological examination involves manual analysis of microscopic tissue images, which can be time-consuming, subjective, and prone to human error. With recent advances in Artificial Intelligence (AI) and Deep Learning (DL), automated systems can now assist pathologists by providing quick and accurate diagnostic insights. Convolutional Neural Networks (CNNs) have shown significant promise in classifying histopathological images by learning complex patterns and differentiating between benign and malignant tissue samples.

## II. RESEARCH GAP

Although AI and deep learning models have been applied to histopathological image classification, most existing models face challenges in generalization across diverse datasets and lack interpretability. Furthermore, there is a need for explainable AI models that not only provide accurate classification but also offer visual explanations for clinical validation. This research aims to address these gaps by developing a robust and interpretable CNN-based model for breast cancer detection.

## III. OBJECTIVES

The main objectives of this study are:

1. To develop and train a CNN-based model for classification of histopathological images of breast cancer.
2. To compare the performance of the proposed model with existing deep learning architectures such as ResNet50 and EfficientNet.
3. To implement explainability techniques (e.g., Grad-CAM) for visual interpretation of AI model predictions.
4. To evaluate the model's performance using key metrics such as accuracy, sensitivity, specificity, and AUC.

## IV. METHODOLOGY

1. **Dataset:** The study will utilize publicly available breast cancer histopathological image datasets such as BreakHis or Kaggle.
2. **Preprocessing:** Image normalization, resizing, and augmentation techniques will be applied to enhance data variability.
3. **Model Development:** A Convolutional Neural Network (CNN) architecture will be designed and trained for image classification.
4. **Evaluation:** Model performance will be evaluated using accuracy, precision, recall, F1-score, and ROC-AUC metrics.
5. **Explainability:** Grad-CAM visualization will be employed to highlight image regions influencing the model’s decision.
6. **Tools:** Python, TensorFlow, PyTorch, and OpenCV will be used for implementation.

## V. EXPECTED OUTCOME

The study is expected to produce a high-performing and explainable AI model capable of accurately classifying breast cancer histopathological images. The inclusion of explainability tools will enhance trust

and usability among medical professionals. This research will contribute to improved diagnostic efficiency and potentially reduce workload for pathologists.