IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 7, July 2026

DOI: 10.17148/IARJSET.2026.13718

BREAST CANCER RISK ASSESSMENT USING RANDOM FOREST CLASSIFICATION AND TENSORFLOW LITE BASED ANDROID DEPLOYMENT

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Abstract: Breast cancer remains one of the leading causes of cancer-related mortality among women worldwide, making early detection and accurate diagnosis essential for improving patient survival rates. Traditional diagnostic methods often require specialised medical expertise, advanced healthcare facilities, and considerable processing time, which may lead to delays in diagnosis and treatment. To address these challenges, this study proposes an AI-enabled Android application for breast cancer prediction using a Random Forest machine learning classifier. The proposed system utilises a breast cancer diagnostic dataset that undergoes preprocessing, feature selection, and normalisation to enhance data quality and model performance. The dataset is divided into training and testing subsets, and a Random Forest classifier is trained to accurately classify tumours as benign or malignant. The trained model is evaluated using performance metrics such as accuracy, precision, recall, F1-score, and confusion matrix to ensure reliable prediction capability. To enable real-time mobile deployment, the optimised model is converted into TensorFlow Lite format and integrated into an Android application. The mobile application allows users to enter diagnostic parameters and instantly receive prediction results without requiring complex computational resources. Experimental results demonstrate that the proposed model achieves high classification accuracy and effectively distinguishes between benign and malignant cases with minimal prediction errors. The integration of machine learning and mobile healthcare technology provides a cost-effective, accessible, and user-friendly solution for breast cancer risk assessment. The proposed system has the potential to support healthcare professionals in clinical decision-making, facilitate early disease detection, and improve overall healthcare outcomes through intelligent and portable diagnostic assistance.

Keywords: Breast Cancer Prediction, Random Forest Classifier, Machine Learning, Android Application, TensorFlow Lite, Artificial Intelligence, Healthcare Analytics, Early Disease Detection.

1. INTRODUCTION

Breast cancer is one of the most prevalent and life-threatening diseases affecting women worldwide, accounting for a significant number of cancer-related deaths each year. Early detection and accurate diagnosis are critical factors in improving survival rates and reducing mortality. Traditional diagnostic approaches, including mammography, biopsy, and clinical examination, often require specialised medical expertise, advanced healthcare infrastructure, and considerable time for analysis. In many cases, delayed diagnosis can lead to disease progression, making treatment more complex and less effective. Therefore, the development of intelligent and accessible diagnostic support systems has become an important area of research in modern healthcare. Recent advancements in Artificial Intelligence (AI) and Machine Learning (ML) have transformed the healthcare sector by enabling automated disease prediction and decision-

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support mechanisms. Machine learning algorithms can analyse large volumes of clinical and diagnostic data to identify hidden patterns and accurately classify medical conditions. Among various machine learning techniques, the Random Forest classifier has gained significant attention due to its robustness, high predictive accuracy, ability to handle high-dimensional data, and resistance to overfitting. These characteristics make it highly suitable for breast cancer prediction and classification tasks. In addition, the rapid growth of mobile technologies has created new opportunities for delivering healthcare services through portable and user-friendly applications. Android-based healthcare solutions enable real-time access to diagnostic tools, making healthcare support more accessible to both medical professionals and patients. Integrating machine learning models into mobile applications allows users to obtain instant predictions without requiring continuous internet connectivity or access to sophisticated computing resources. This study proposes an AI-enabled Android application for breast cancer prediction using a Random Forest classifier. The diagnostic dataset is pre-processed and used to train an accurate classification model capable of distinguishing between benign and malignant tumours. The trained model is converted into TensorFlow Lite format and deployed within an Android application to facilitate real-time prediction on mobile devices. The proposed system aims to support early disease detection, improve diagnostic efficiency, and assist healthcare professionals in making informed clinical decisions. By combining machine learning intelligence with mobile healthcare technology, the system offers an accessible, reliable, and cost-effective solution for breast cancer risk assessment and early diagnosis.

2. LITERATURE REVIEW

This study investigates the application of various machine learning models for breast cancer detection and diagnosis. The authors evaluated multiple classification algorithms using clinical breast cancer datasets to determine their predictive effectiveness. The research highlights the importance of data preprocessing, feature selection, and model optimization in improving classification accuracy. Experimental results demonstrated that machine learning techniques can effectively distinguish between benign and malignant tumours with high reliability. The study concludes that AI-based diagnostic systems can support healthcare professionals in early disease detection and clinical decision-making, ultimately contributing to improved patient outcomes and reduced diagnostic errors.[1]

This research presents a hybrid breast cancer diagnosis framework that combines Deep Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), and Random Forest classifiers. The proposed model extracts complex features from medical datasets and enhances classification performance through ensemble learning techniques. The study demonstrates that integrating deep learning with Random Forest classification improves predictive accuracy and robustness compared to traditional machine learning approaches. The results indicate superior performance in identifying breast cancer cases, reducing false predictions, and supporting early diagnosis. The proposed methodology provides an efficient and reliable framework for intelligent healthcare applications.[2]

The authors explored several machine learning techniques for breast cancer detection and conducted a comparative analysis of their performance. The study utilized publicly available breast cancer datasets and applied preprocessing methods to improve data quality. Different classifiers were evaluated based on accuracy, precision, recall, and F1-score. The findings revealed that machine learning algorithms can significantly improve diagnostic accuracy and assist in identifying cancerous conditions at an early stage. The research emphasizes the potential of AI-driven healthcare systems in reducing manual diagnostic efforts and supporting effective medical decision-making processes.[3]

This study focuses on the use of machine learning and deep learning models for early breast cancer prediction. The authors analyzed multiple predictive algorithms and compared their effectiveness in classifying breast cancer cases. The research demonstrates that advanced AI models can achieve higher diagnostic accuracy than conventional methods. The proposed framework improves prediction reliability through automated feature extraction and intelligent classification. The study concludes that integrating machine learning technologies into healthcare systems can enhance early detection, reduce diagnostic delays, and improve treatment planning for breast cancer patients..[4]

3. METHODOLOGY

The proposed system utilises a breast cancer diagnostic dataset that undergoes preprocessing, including data cleaning, feature selection, and normalisation. The processed data is divided into training and testing sets to develop a Random Forest classifier for accurate tumour classification. The trained model is evaluated using performance metrics such as accuracy, precision, recall, F1-score, and confusion matrix. After validation, the model is converted into TensorFlow Lite format and integrated into an Android application. The mobile application enables users to input diagnostic parameters and obtain real-time breast cancer prediction results for effective clinical decision support.

3.1 PROBLEM STATEMENT

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Early Breast cancer diagnosis in existing healthcare systems often relies on manual clinical assessment and traditional diagnostic procedures, which can be time-consuming and prone to human error. Many conventional methods require specialised medical expertise and expensive diagnostic equipment, limiting accessibility in resource-constrained environments. Existing prediction systems frequently lack real-time mobile deployment and efficient decision-support capabilities. Delays in diagnosis may reduce the effectiveness of early treatment and negatively impact patient outcomes. Therefore, there is a need for an accurate, accessible, and intelligent breast cancer prediction system that can support timely clinical decision-making.

3.2 Objective

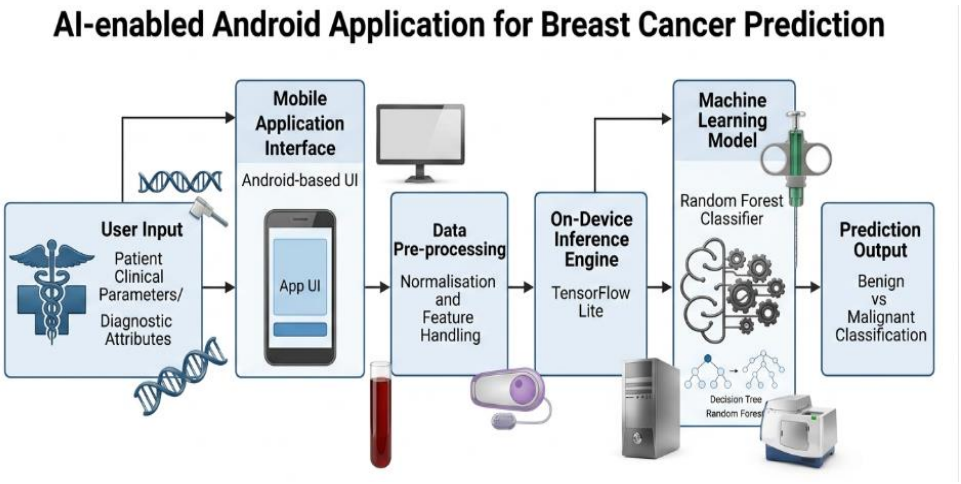
The objective of this study is to develop an intelligent Android-based breast cancer prediction system using a Random Forest machine learning classifier. The system aims to analyse patient diagnostic data and accurately classify cases as benign or malignant. It integrates a trained machine learning model with TensorFlow Lite for real-time prediction on mobile devices. The proposed application seeks to support early detection and assist healthcare professionals in clinical decision-making. Additionally, it provides a user-friendly and accessible platform for rapid breast cancer risk assessment.

3.3 Proposed system

The proposed system presents an AI-enabled Android application for breast cancer prediction using a Random Forest classifier. Patient diagnostic attributes are processed through a trained machine learning model to classify tumours as benign or malignant with high accuracy. The model is optimised and deployed using TensorFlow Lite to enable efficient on-device inference. A user-friendly mobile interface allows users to input clinical parameters and obtain real-time prediction results. The system enhances early disease detection, reduces diagnostic delays, and supports healthcare professionals in making informed clinical decisions. Furthermore, the mobile-based architecture ensures accessibility, portability, and scalability for practical healthcare applications.

3.5 Proposed system with advantages

- The Random Forest classifier provides reliable and accurate classification of breast cancer cases, reducing the likelihood of diagnostic errors.
- The system facilitates the early identification of malignant tumours, enabling timely medical intervention and improving patient outcomes.
- Integration with TensorFlow Lite allows fast and efficient on-device inference, providing instant prediction results through an Android application.
- The Android-based interface offers a simple and intuitive platform for healthcare practitioners and users to perform breast cancer risk assessment anytime and anywhere.
- The proposed system serves as a decision-support tool that can assist healthcare professionals in preliminary diagnosis, reducing workload and supporting evidence-based medical decisions.



4. RESULT ANALYSIS

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The Random Forest Classifier demonstrated excellent performance in the breast cancer prediction task, achieving an overall accuracy of **99.27%**, which indicates a highly reliable classification capability. The classification report shows that Class 0 (Benign) achieved a precision of **0.99**, a recall of **1.00**, and an F1-score of **0.99**, meaning that nearly all benign cases were correctly identified with minimal misclassification. Similarly, Class 1 (Malignant) achieved a precision of **1.00**, a recall of **0.99**, and an F1-score of **0.99**, indicating exceptional performance in detecting malignant tumours while maintaining a very low false positive rate.

The macro average and weighted average values of **0.99** for precision, recall, and F1-score further confirm the robustness and consistency of the model across both classes. The high recall values demonstrate the model's effectiveness in identifying actual cancer cases, which is crucial in medical diagnosis, where missed detections can have serious consequences. Additionally, the balanced precision and recall scores indicate that the model is not biased toward any specific class. Overall, the Random Forest Classifier provides highly accurate and dependable predictions, making it a suitable solution for real-time breast cancer diagnosis and clinical decision-support applications through the proposed Android-based healthcare system.

```
Accuracy: 0.9927272727272727

Classification Report:
              precision    recall  f1-score   support

           0       0.99      1.00      0.99       694
           1       1.00      0.99      0.99       406

    accuracy                           0.99      1100
   macro avg       0.99      0.99      0.99      1100
weighted avg       0.99      0.99      0.99      1100
```

Figure 1 Accuracy report

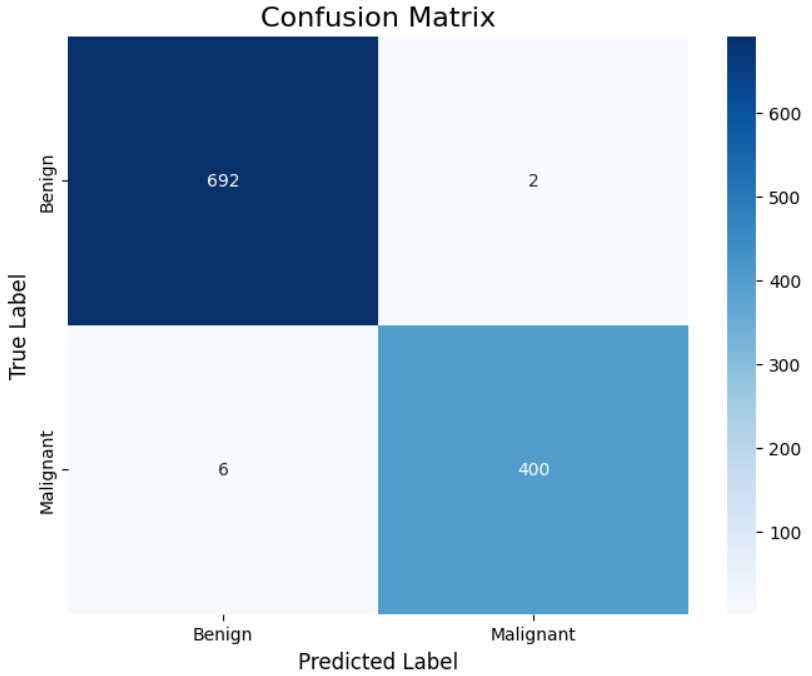

Figure 2 Confusion matrix for the Random Forest classifier

The developed Android application provides a simple and user-friendly interface for breast cancer prediction. Users are required to enter the diagnostic parameters, including Radius Mean, Texture Mean, and Perimeter Mean, into the input

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fields provided on the home screen. Upon clicking the **Predict** button, the application processes the entered values through the trained Random Forest machine learning model integrated within the system.

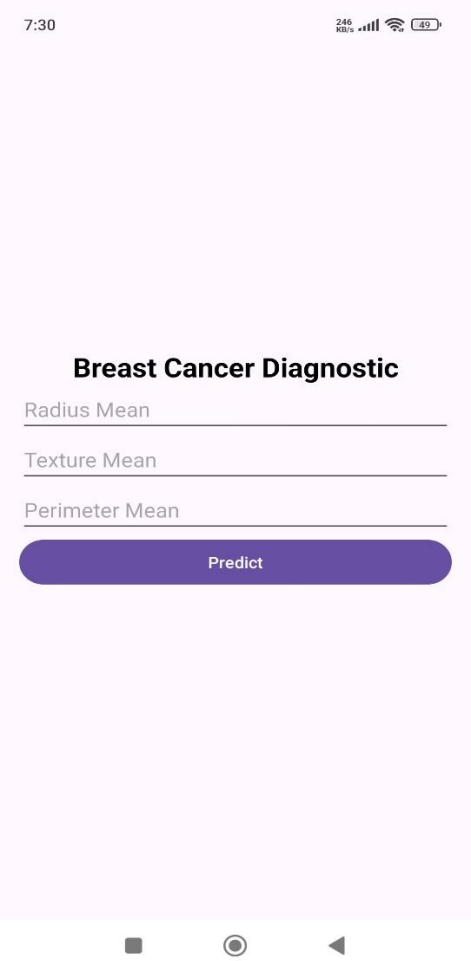

Figure 3 After detection in the Android application

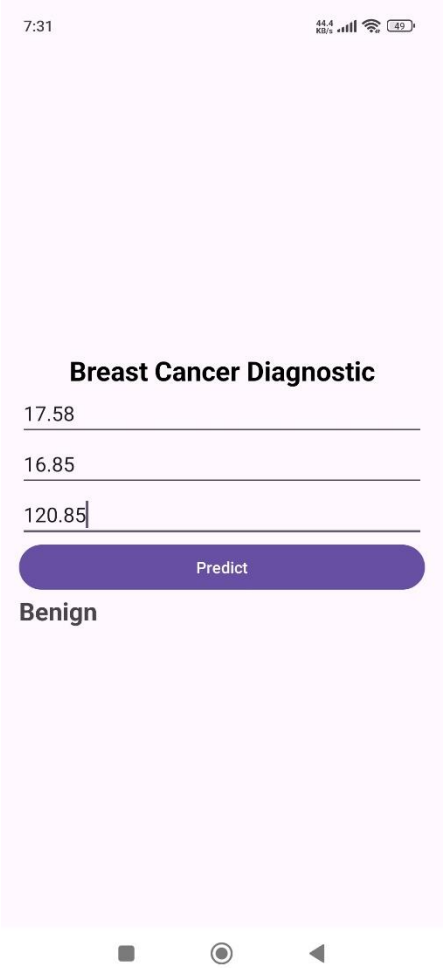

Figure 4 before detection in an Android application

5. CONCLUSION

In conclusion, the proposed AI-enabled Android application for breast cancer prediction provides an accurate, efficient, and accessible solution for early disease detection. The Random Forest classifier achieved an impressive prediction accuracy of 99%, demonstrating its capability to reliably distinguish between benign and malignant breast cancer cases. Unlike existing systems that often rely on manual diagnosis, specialised expertise, and time-intensive clinical procedures, the proposed approach delivers rapid and real-time predictions through a mobile platform. The integration of TensorFlow Lite enables seamless on-device inference, reducing computational overhead and eliminating the need for continuous internet connectivity. Furthermore, the Android-based implementation enhances portability, user accessibility, and practical usability in diverse healthcare environments. The high accuracy, low prediction error, and real-time processing capabilities make the proposed system more effective than conventional diagnostic support methods. Overall, the proposed framework contributes to improved diagnostic accuracy, early medical intervention, reduced healthcare burden, and better patient outcomes, making it a valuable tool for modern healthcare applications.

6. FUTURE ENHANCEMENT

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The further enhanced by integrating advanced deep learning models to improve prediction accuracy and support more complex diagnostic analysis. Future versions may incorporate medical image processing using mammogram and ultrasound images for comprehensive breast cancer detection. Cloud-based data storage and real-time synchronization can be added to facilitate remote healthcare monitoring and clinical collaboration. The application can also be extended with explainable AI techniques to provide transparent prediction results and increase user trust. Additionally, integrating electronic health records and multilingual support would improve accessibility, scalability, and practical adoption in diverse healthcare environments.

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