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(57) Abstract :
Breast cancer is one of the most common and life-threatening diseases among women globally, thus early and precise detection is critical to improve survival rates and treatment results. To do this, a secure and efficient breast cancer categorization system is created by combining machine learning and cryptographic methods. Unlike standard methods that use Support Vector Machines (SVM) for model training, Random Forest and XGBoost are used to improve predictive accuracy. However, securing sensitive patient data remains a top priority in medical applications. To overcome this, CKKS homomorphic encryption is used, which enables encrypted data processing without the need for decryption, ensuring data privacy and security. Before training the XGBoost model, the dataset is thoroughly preprocessed, including missing value management, feature standardization, and SMOTE-based class imbalance correction. During prediction, fresh patient data is encrypted and securely sent, and homomorphic computations are carried out without disclosing sensitive information. The encrypted results are then returned, decrypted, and evaluated to determine the final diagnosis. To validate the effectiveness of this strategy, performance is measured using accuracy, precision, recall, and F1-score, resulting in a highly accurate and privacy-preserving breast cancer detection system. By merging modern machine learning models with safe cryptographic approaches, this framework provides both medical dependability and patient data confidentiality, providing a reliable solution for breast cancer diagnosis.

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