European Project Semester

PROJECT OUTLINE

Project dates: Mars – June 2026	
Title: Explainable Artificial Intelligence for the risk detection of breast cancer	
Project activity areas: Machine Learning, Prediction Models, communication with pathologists or radiologists, diagnostic accuracy	**Keywords:** Deep Learning, Classification, Interpretability, Evaluation Metrics, Medical data
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Project technical background:

Breast cancer is a major health issue, affecting more than 2 million people worldwide every year, with over 600,000 deaths [1]. In the World, mortality rates have increased in recent years, especially among women under 40 years old. Early diagnosis is key to increasing the chances of a cure.

In recent years, several studies applying artificial intelligence and deep neural networks to mammogram images to assess breast cancer risk have been published in the literature. Such approaches have already helped reduce human errors and the delay in breast cancer diagnosis [2]. Indeed, using a Deep Learning Mammography-based Model on 88 994 consecutive screening mammograms in 39 571 women, Yala et al, evaluated retrospectively Breast Cancer Risk Prediction [3]. They found that convolutional neural networks (CNNs), achieved an accuracy of 94% in classifying screening mammograms, including information about cancer risk. Given the recent advances in deep learning, much can still be done in this domain to reduce errors and false diagnoses.

Our project intends to begin with a thorough updated literature review. The systematic review presented in [4] is a valuable starting point, as it was published in 2024 and summarizes the methods and performance metrics reported in recent academic literature. One significant gap in the literature is the comparison between proposed methods, as they are usually tested in different scenarios and with different datasets. This is one of the aspects that will be addressed in this project.

Additionally, recently proposed methods that have not yet been applied in this context—such as Independent Vector Analysis (IVA), an appealing unsupervised learning method, which can be used for feature extraction—will be tested. IVA has promising applications, such as in audio/speech signal separation, medical signal processing, remote sensing, video/image processing, wireless communication processing, and so on. IVA has been widely used in functional magnetic resonance imaging (fMRI) [5,6] and also with electroencephalogram (EEG) signals [6], showing promising results in improving classification accuracy.

The project aims to involve European Project Semester (EPS) students. It will also benefit from collaboration with the medical community, with which Prof. Bernard Kamsu Foguem is already engaged. Medical input will be essential for data selection, defining the objectives of data processing, and interpreting the results.

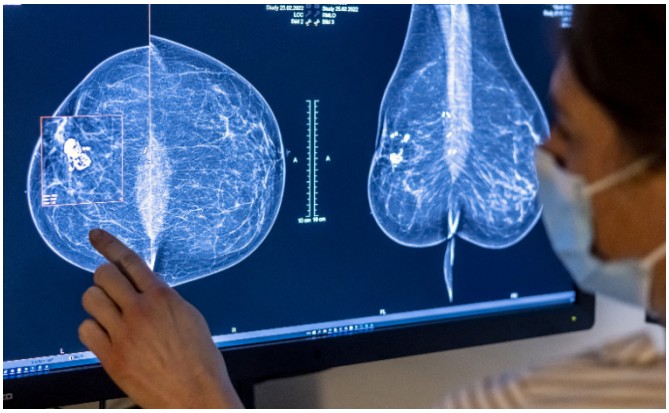

Fig. 1: AI mammography detects more cancers, cuts workload

Fig. 2: AI-powered breast cancer detection

The purpose of the current project is to provide a structured overview of the current state of Machine Learning-based breast cancer detection and outline future directions for research and clinical adoption. An emphasis would be placed on explainable machine learning that means humans can capture relevant knowledge from a model concerning relationships either contained in data or learned by the model. In concert with clinical trials, radiologists need to agree on a single comprehensive interpretation standard in terms of assessment, classification system, terminology, reporting, and follow-up monitoring. Improving Explainability for Radiologists remains a critical challenge:

- Identification of the suspected location of tumors, and their features that may help the radiologist to correctly interpret the image.
- Translating these features into semantic concepts and developing texture models that are more understood by the radiologist needs further research.

References:

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Studied topics:

- Literature review of machine learning algorithms for breast cancer
- Summarization of how ML algorithms help differentiate malignant and benign breast tumors.
- Exploration of various machine learning models for breast cancer classification.
- Evaluation of class imbalance, model interpretability, and generalizability.
- Make a typical use-case and experimental test to enhance the clinical applicability, trustworthiness, and integration of ML-based diagnostic systems.