Mohammed VI Polytechnic University (UM6P)
International Artificial Intelligence Center of
Morocco (Ai movement)

Multi-modal Data Integration and Processing for Breast Cancer Screening

Amal El Fallah Seghrouchni, Youssef Alj

Keywords— breast cancer, screening, diagnosis, multi-modal data, deep neural networks.

1 Research motivation

Breast cancer is a public health problem in Morocco. Indeed, this cancer is the first women's cancer with a rate of 34.3% of all cancers affecting women[1]. Early identification of this cancer helps treating patients more effectively and therefore increase the survival rate. In addition to clinical examination the two most commonly used imaging techniques are mammography and ultrasound. Mammography is the most widely used imaging tool for screening and early detection of breast cancer. Nevertheless, this technique has some limitations: For a woman with high breast density, the sensitivity of mammography drops to 48%[2]. Besides, mammography is not always accessible, especially in rural areas where the cost of equipment is prohibitive and radiologists are less present than in town. Ultrasound plays an important role in the diagnosis of breast cancer. It is often prescribed as an adjunct to mammography for screening. On the other hand, Computer Aided Diagnosis (CAD), has experienced dazzling progress thanks to the development of artificial intelligence and more particularly deep learning with Convolutional Neural Networks (CNNs) [3]. The use of CNNs in medical imaging has been very successful, particularly in helping to diagnose breast cancer. Such techniques take as input one of the three modalities: Mammography [7], ultrasound [4, 5] or Magnetic Resonance Imaging (MRI) [6].

2 Problem statement

The approaches mentioned above generally take a single type of image (ultrasound or mammography or MRI) while excluding the others. However, in order to diagnose the disease accurately, radiolgists take into account several sources of information: breast palpation, patient's age and family history, ultrasound, mammography, MRI, etc. Few research efforts have investigated the

[1] www.sante.gov.ma

integration of heterogeneous data for breast cancer diagnosis. [1] surveys such methods which date from 2014 and do not take into account recent developments in deep learning.

3 Research scope

The aim of this thesis is to exploit all the available data in order to increase breast cancer detection accuracy. Intuitively, this holistic approach integrating heterogeneous data (X-rays, ultrasound, etc.) and multi-modal data (text, images, etc.) could give better accuracy compared to approaches using a single data source. The goal is to use recent advances in artificial intelligence, particularly in deep learning, and to propose a new architecture that incorporates these different modalities and predict whether the tumor is benign or malignant. Figure 1 summarizes the proposed approach.

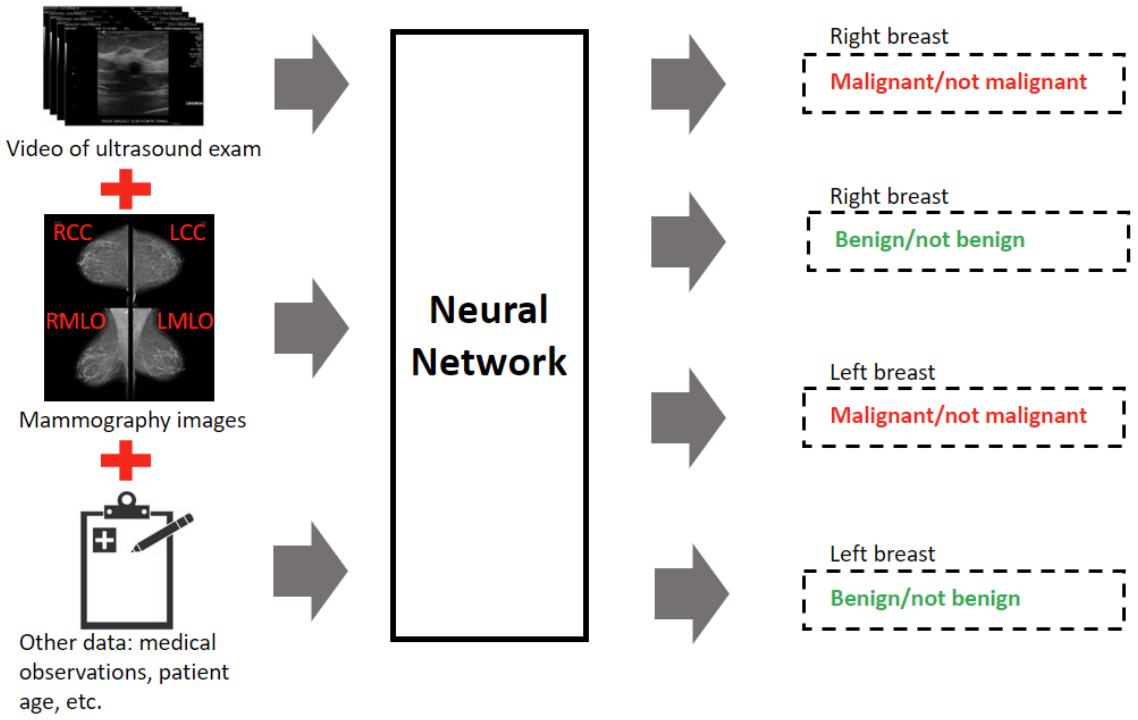

Figure 1: Proposed approach for breast cancer detection.

4 Admission criteria

The PhD position is proposed by the International Center of Artificial Intelligence of Morocco, of the Mohammed VI Polytechnic University. Applicants with excellent curriculum must be holders of a Master, an engineering or an equivalent recognized degree in image processing, computer

science or applied mathematics. In addition, programming skills in Python and C++ are required as well as good communication skills in English. Particular attention will be given to the suitability of this research project with the applicant's background.

5 Potential project partners

- Cheikh Khalifa Hospital, Casablanca.
- Cheikh Zayd Hospital, Rabat.

References

[1] Taye Girma Debelee, Friedhelm Schwenker, Achim Ibenthal, and Dereje Yohannes. Survey of deep learning in breast cancer image analysis. *Evolving Systems*, 11(1):143–163, 2020.

[2] Thomas M Kolb, Jacob Lichy, and Jeffrey H Newhouse. Comparison of the performance of screening mammography, physical examination, and breast us and evaluation of factors that influence them: an analysis of 27,825 patient evaluations. *Radiology*, 225(1):165–175, 2002.

[3] Yann LeCun, Yoshua Bengio, and Geoffrey Hinton. Deep learning. *nature*, 521(7553):436–444, 2015.

[4] Haixia Liu, Guozhong Cui, Yi Luo, Yajie Guo, Lianli Zhao, Yueheng Wang, Abdulhamit Subasi, Sengul Dogan, and Turker Tuncer. Artificial intelligence-based breast cancer diagnosis using ultrasound images and grid-based deep feature generator. *International Journal of General Medicine*, 15:2271, 2022.

[5] Yiqiu Shen, Farah E Shamout, Jamie R Oliver, Jan Witowski, Kawshik Kannan, Jungkyu Park, Nan Wu, Connor Huddleston, Stacey Wolfson, Alexandra Millet, et al. Artificial intelligence system reduces false-positive findings in the interpretation of breast ultrasound exams. *Nature communications*, 12(1):1–13, 2021.

[6] Jan Witowski, Laura Heacock, Beatriu Reig, Stella K Kang, Alana Lewin, Kristine Pysarenko, Shalin Patel, Naziya Samreen, Wojciech Rudnicki, Elżbieta Łuczyńska, et al. Improving breast cancer diagnostics with deep learning for mri. *Science Translational Medicine*, 14(664):eabo4802, 2022.

[7] Nan Wu, Jason Phang, Jungkyu Park, Yiqiu Shen, Zhe Huang, Masha Zorin, Stanisław Jastrzębski, Thibault Févry, Joe Katsnelson, Eric Kim, et al. Deep neural networks improve radiologists' performance in breast cancer screening. *IEEE transactions on medical imaging*, 39(4):1184–1194, 2019.