Project Title

MAMMOGRAPHY IMAGE ANALYSIS FOR BREAST CANCER RISK ASSESSMENT

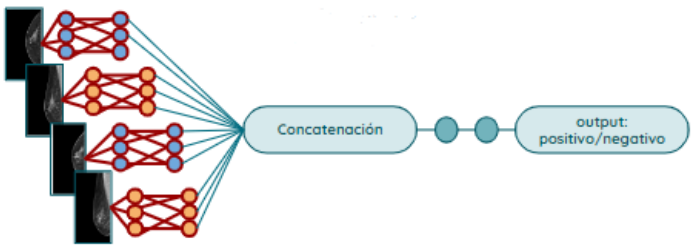
Project abstract

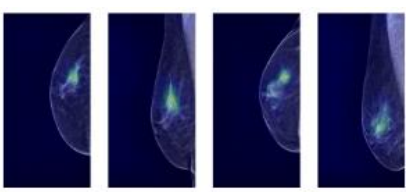
The goal of the project is to develop fair artificial intelligence (AI) models for breast cancer screening and risk assessment scenarios. Lately, the scientific community is shifting from developing traditional CAD systems that highlight suspicious masses or calcifications within the mammograms to the analysis of complete imaging studies directly, using deep learning algorithms. Following this idea, we aim at improving the performance of breast cancer screening algorithms by using a large database known as OPTIMAM, to which we already have access. The final aim is to pave the way toward the development of an AI-assisted solution generalizable to different hospitals and devices so that specialists and patients could benefit from the service with the same performance.

Extended abstract

Lately, the scientific community is shifting from developing traditional CAD systems that highlight suspicious masses or calcifications within the mammograms to the analysis of complete imaging studies [1-6], which may also consider other features such as asymmetries or distortions. These features are widely evaluated by radiologists, for example during screening. Deep learning has become essential in the aforementioned scenario, which implies the need of having huge amounts of data to train the algorithms. However, in some cases, the variability in the data is scarce and comes from a few sources of origin (hospitals, manufacturers…). Thus, solutions are not robust enough to be used by health care systems with multiple acquisition devices and protocols and are commonly biased towards a certain manufacturer.

Vicomtech developed preliminary work on deep learning algorithms to classify mammography studies into positive and negative screening based on 2D mammogram studies. The private dataset used came from up to 4 different manufacturers, 31 mammographers, and several hospitals with different acquisition parameters. Thus, preprocessing techniques were explored and applied to overcome biases derived from the variability of acquisition sources. The architecture employed was based on [2] using DenseNet121 as feature extractor. Specifically, the four study instances were used to decide whether a study was a negative or positive screening exam. The features extracted from the different instances after using DenseNet121 were combined between breast views. Furthermore, visual explanations of the outcome of the classification algorithms were given using SmoothGrad [7] and GradCAM [8], highlighting suspicious regions on the image. However, the reduced number of cases employed led to results that could be highly improved by adding extra exams from different manufacturers, acquisition devices, and protocols, which may as well require redefining the architecture and training approach. Mass localization annotations and pathology report information could be leveraged during training.





Hence, the aim of the project is to improve the current approach by investigating new methodologies (including the development of models using mammograms to predict risk at multiple time points) and using a large dataset of 6000 cases coming from OPTIMAM (already available at Vicomtech). Furthermore, visual explanations will also be included in the outcome of the algorithm.

[1] McKinney, S. M., Sieniek, M., Godbole, V., Godwin, J., Antropova, N., Ashrafian, H., ... & Shetty, S. (2020). International evaluation of an AI system for breast cancer screening. Nature, 577(7788), 89-94.

[2] Wu, N., Phang, J., Park, J., Shen, Y., Huang, Z., Zorin, M., ... & Geras, K. J. (2019). Deep neural networks improve radiologists' performance in breast cancer screening. IEEE transactions on medical imaging, 39(4), 1184-1194.

[3] Yala, A., Mikhael, P. G., Strand, F., Lin, G., Satuluru, S., Kim, T., ... & Barzilay, R. (2021). Multi-institutional validation of a mammography-based breast cancer risk model. Journal of Clinical Oncology, JCO-21.

[4] Yala, A., Mikhael, P. G., Strand, F., Lin, G., Smith, K., Wan, Y. L., ... & Barzilay, R. (2021). Toward robust mammography-based models for breast cancer risk. Science Translational Medicine, 13(578), eaba4373.

[5] Lång, K., Hofvind, S., Rodríguez-Ruiz, A., & Andersson, I. (2021). Can artificial intelligence reduce the interval cancer rate in mammography screening?. European Radiology, 31(8), 5940-5947.

[6] Larsen, M., Aglen, C. F., Lee, C. I., Hoff, S. R., Lund-Hanssen, H., Lång, K., ... & Hofvind, S. (2022). Artificial Intelligence Evaluation of 122 969 Mammography Examinations from a Population-based Screening Program. Radiology, 212381.

[7] Daniel Smilkov, Nikhil Thorat, Been Kim, Fernanda Viegas ´ and Martin Wattenberg. (2017) SmoothGrad: removing noise by adding noise.

[8] Ramprasaath R. Selvaraju, Abhishek Das, Ramakrishna Vedantam, Michael Cogswell, Devi Parikh and Dhruv Batra. (2016). Grad-CAM: Why did you say that? Visual Explanations from Deep Networks via Gradient-based Localization

About Vicomtech Foundation

Vicomtech (www.vicomtech.org) is a private Applied Research Center specialized in Artificial Intelligence, Visual Computing and Interaction located in San Sebastian and Bilbao. Vicomtech is a member of the Basque Research and Technology Alliance (BRTA) and GraphicsVision.ai, an international network specialized in Computer Graphics (https://graphicsvision.ai/).

The Digital Health and Biomedical Technologies Department is a source of innovative developments for the biomedical sector, with applications such as biomedical image analysis, biomedical simulation, decision support systems, computer assisted surgery, big data, precision medicine and many others. It currently has various EU projects in the Horizon 2020 and Horizon Europe programs, and collaborates with companies, health institutions, technology centers and universities in the development of innovative digital solutions in the biomedical sector.

We offer:

A multicultural and multidisciplinary research environment.

Being part of a leading team in the field of Digital Health technologies research at an international level, with a successful track record of technology transfer.

Joining a dynamic, innovative, and leading Center in the field of Artificial Intelligence and Visual Computing & Interaction at international level with work centers in San Sebastian and Bilbao.

Personal development through training and educational opportunities.

Career opportunities and professional progression.

A grant of €1050/month on a full-time basis (or its equivalent on a part-time basis).