TRUSTWORTHY AI FOR SIGNALS AND IMAGE PROCESSING: A TELEMEDICINE PERSPECTIVE

Consiglio Nazionale delle Ricerche

MOTIVATION

Artficial Intelligence is showing unprecedented performance in signals & image processing. Classificaction, segmentation and generative process seem to have unlimited potential.

The roots of Artificial Intelligence are deep in scientific history, but in the world of Big Data and Internet 5.0, its use and effects have yet to be entirely tested.

The black box problem, security, privacy issues, and public opinion are some of the factors that push towards the development of a new concept: "Trustworthy AI".
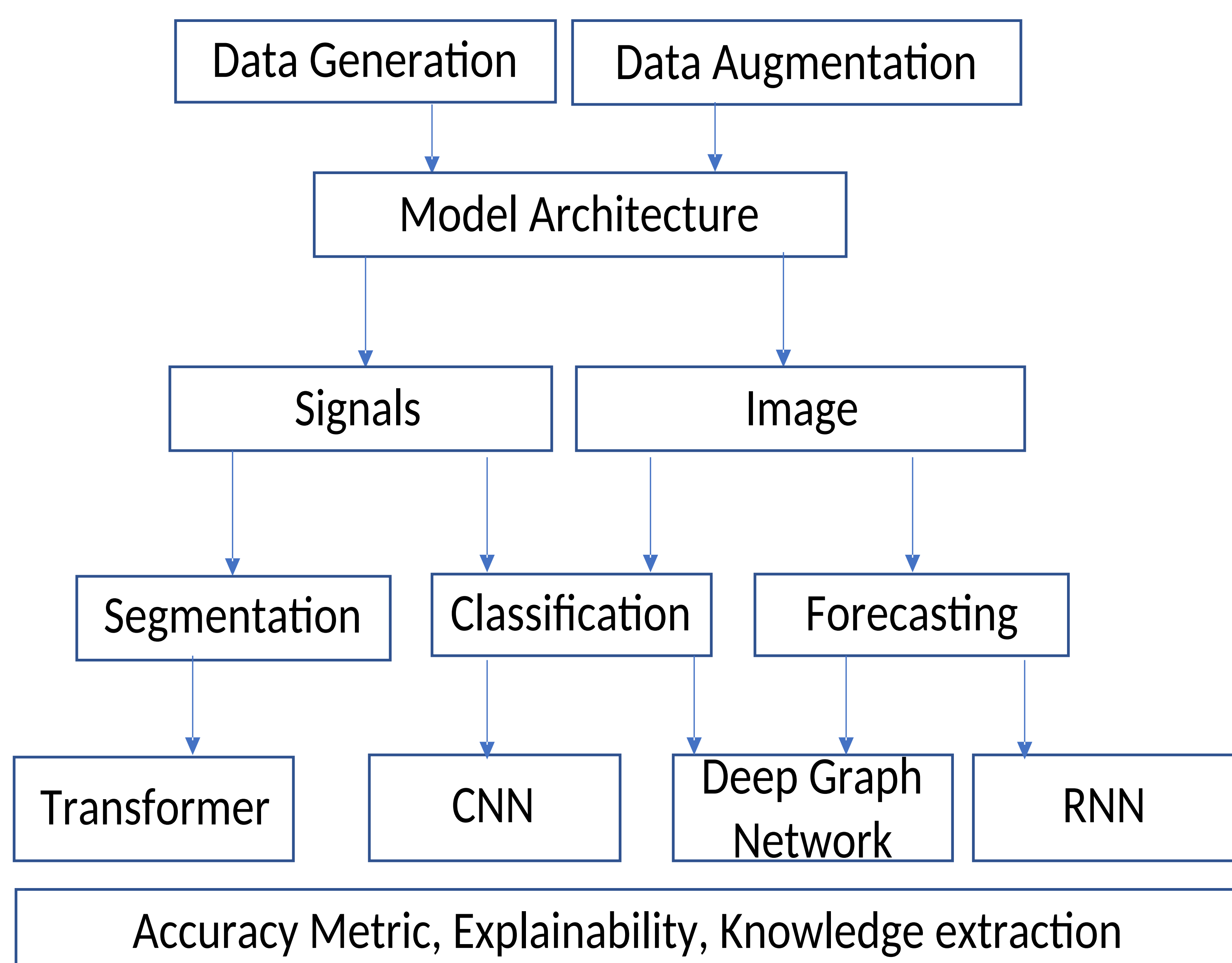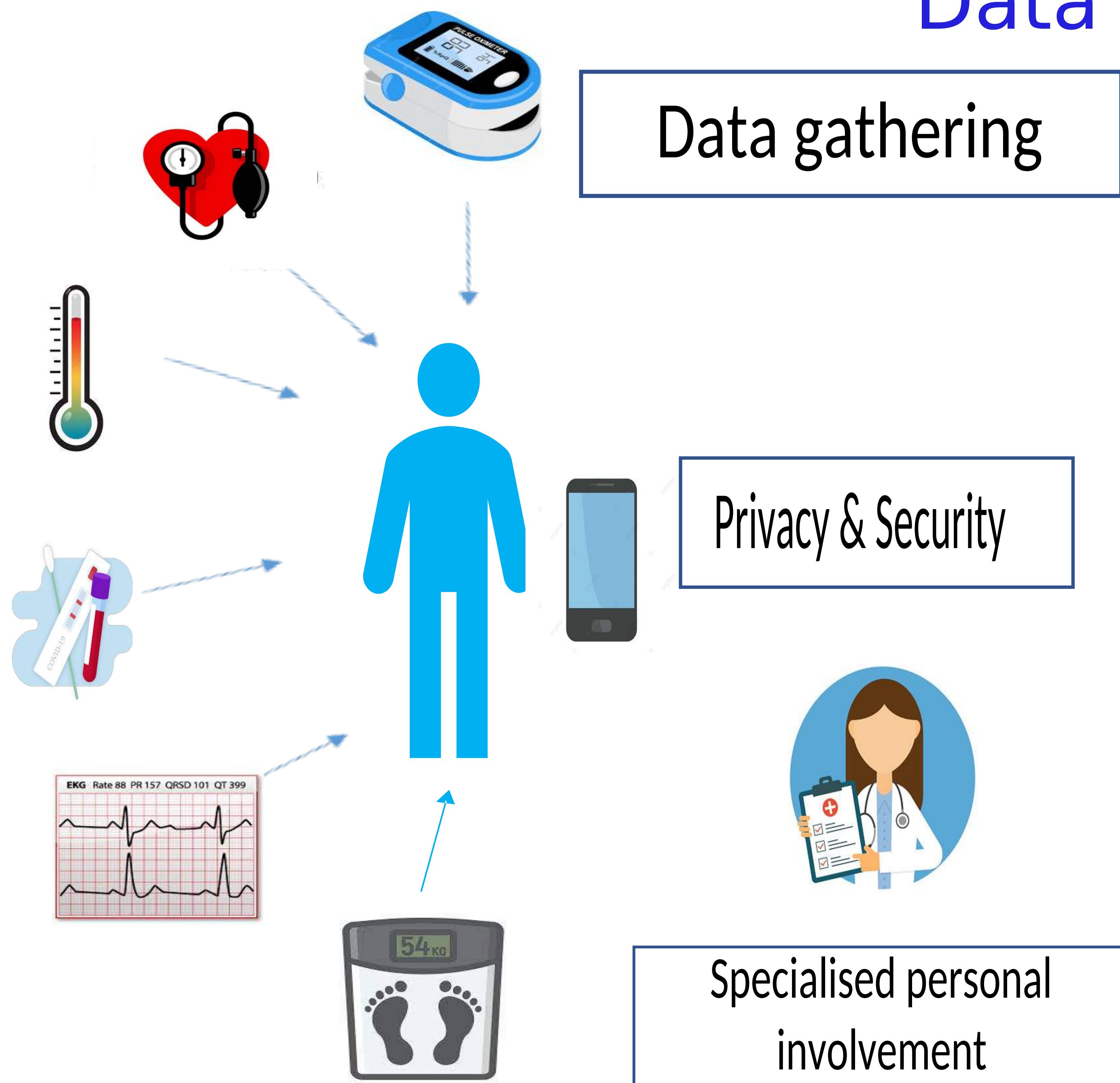
Key concept: Trustworthy AI

An interesting among the many possible definitions of Trustworthy AI argues that an AI should follow some defined **guidelines & concepts** to use[1]:

- LAWFUL
- ETHICAL
- ROBUST
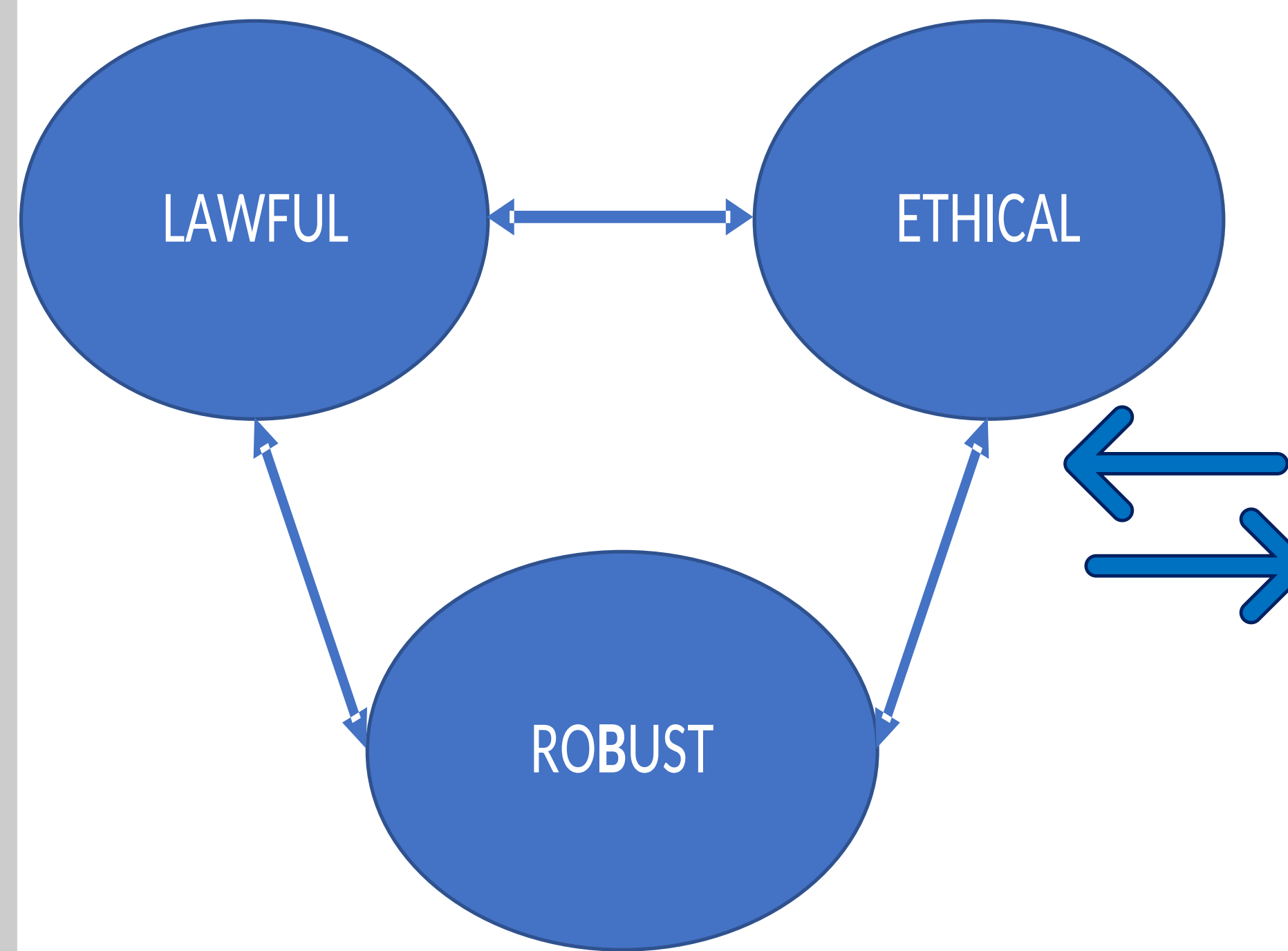
1. Human agency and oversight
2. Technical Robustness & safety
3. Privacy & Data governance
4. Diversity, non-discrimination & fairness
5. Societal & enviromental well-being
6. Accountability
7. Transparency

Objectives: a development of a trustworthy AI approach for Telemedicine Application

Data and Methods

Data gathering

Privacy & Security

Specialised personal involvement

Data Generation — Data Augmentation → Model Architecture → Signals / Image

Signals → Segmentation / Classification
Image → Forecasting

Segmentation → Transformer
Classification → CNN
Forecasting → Deep Graph Network / RNN

Accuracy Metric, Explainability, Knowledge extraction

FIRST RESULTS & DISCUSSION

A beginning goal involves an analysis of academic works, with the aim of replicating them and update the state of the art [2,3,6,7].
The use of advanced methods, such as EfficientNet & GradCAM, leads to remarkable accuracy and consistent explanation in the classification of ultrasound which can be further investigated, fig.1[4,7]. Data augmentation & generation appear to be key factors to guarantee concepts such as privacy and fairness, fig.2[5]. The image transformer will be the intrinsic next step[8].

Further studies aim at analyzing results could lead to a more robust application of AI in the generalized field of signal and image processing and will lay the foundation for future work on reliable AI.
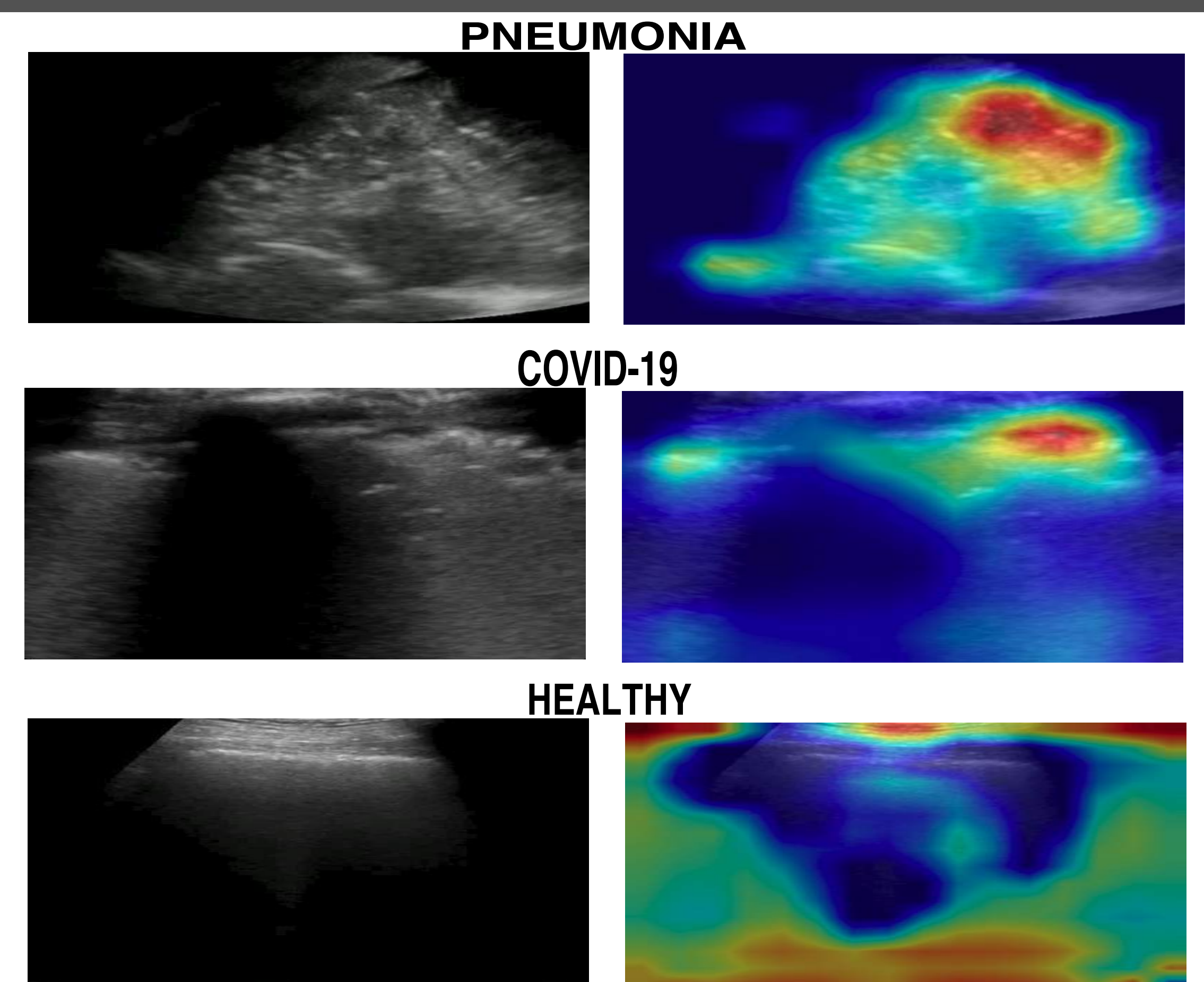
PNEUMONIA

COVID-19

HEALTHY

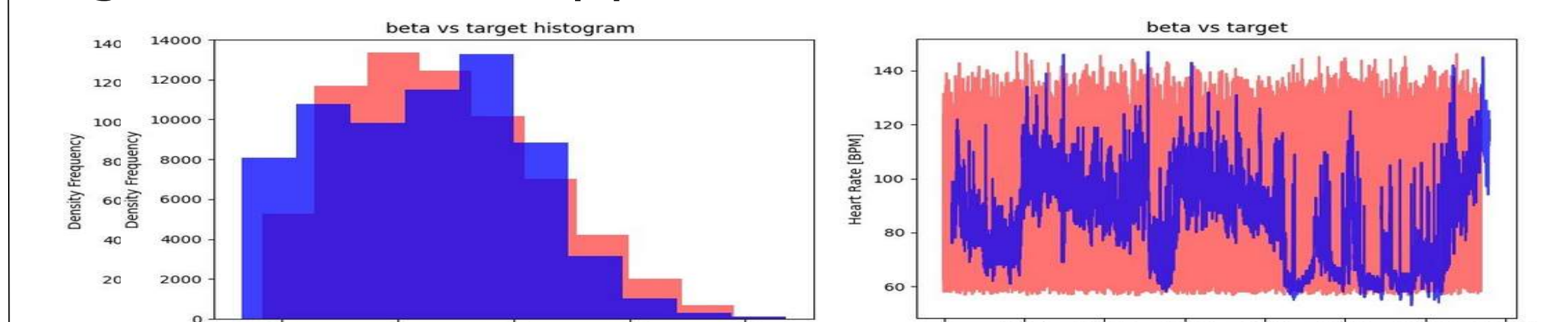Fig.1-Grad-CAM application on POCUS classification

Fig.2-Data Augmention approach for vital signs forecasting

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[3]Selvaraju, Ramprasaath R., et al. "Grad-cam: Visual explanations from deep networks via gradient-based localization." 2017.
[4]Bruno, A., Ignesti, G., Salvetti, O., Moroni, D., & Martinelli, M. (2023). Efficient Lung Ultrasound Classification. Bioengineering, 10(5), 555.
[5]Ignesti, Giacomo, et al. "An intelligent platform of services based on multimedia understanding and telehealth for supporting the management of SARS-CoV-2 multi-pathological patients." 2022 16th SITIS. IEEE, 2022.
[6]Zhao, L., & Lediju Bell, M. A. (2022). A review of deep learning applications in lung ultrasound imaging of COVID-19 patients. BME Frontiers, 2022.
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[8]He, Kelei, et al. "Transformers in medical image analysis: A review." Intelligent Medicine (2022).