DEEPHEALTH

Deep-Learning and HPC to Boost Biomedical Applications for Health

An introduction to the project

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825111.

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DEEPHEALTH, a H2020 European innovation Project that aims to push the use of technology for Health to boost new and more efficient biomedical image applications for the diagnose, monitoring and treatment of diseases.

A Project coordinated by NTT DATA UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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Key facts

H2020 call ICT-11 2018-2019

HPC and Big Data enabled Large-scale Test-beds and Applications

Starting date / Duration

January 2019 / 42 months

Total budget / EU contribution

14.642.366 € / 12.774.824 €

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A Little bit of context

- Healthcare: key sector in the global economy
- Public health systems generate large datasets of biomedical images
  - Large unexploited knowledge database
  - Interpretation of the clinical expert manually
- R & D on applying Artificial Intelligence (AI) to analyze biomedical images but . . .
  - Need for advanced skills in AI and different technologies and tools
  - Expensive processes in time and resources
  - Needs of high-quality data and take care of ethics
- HPC and BigData technologies (Big Data, HPC) sufficiently mature and available.

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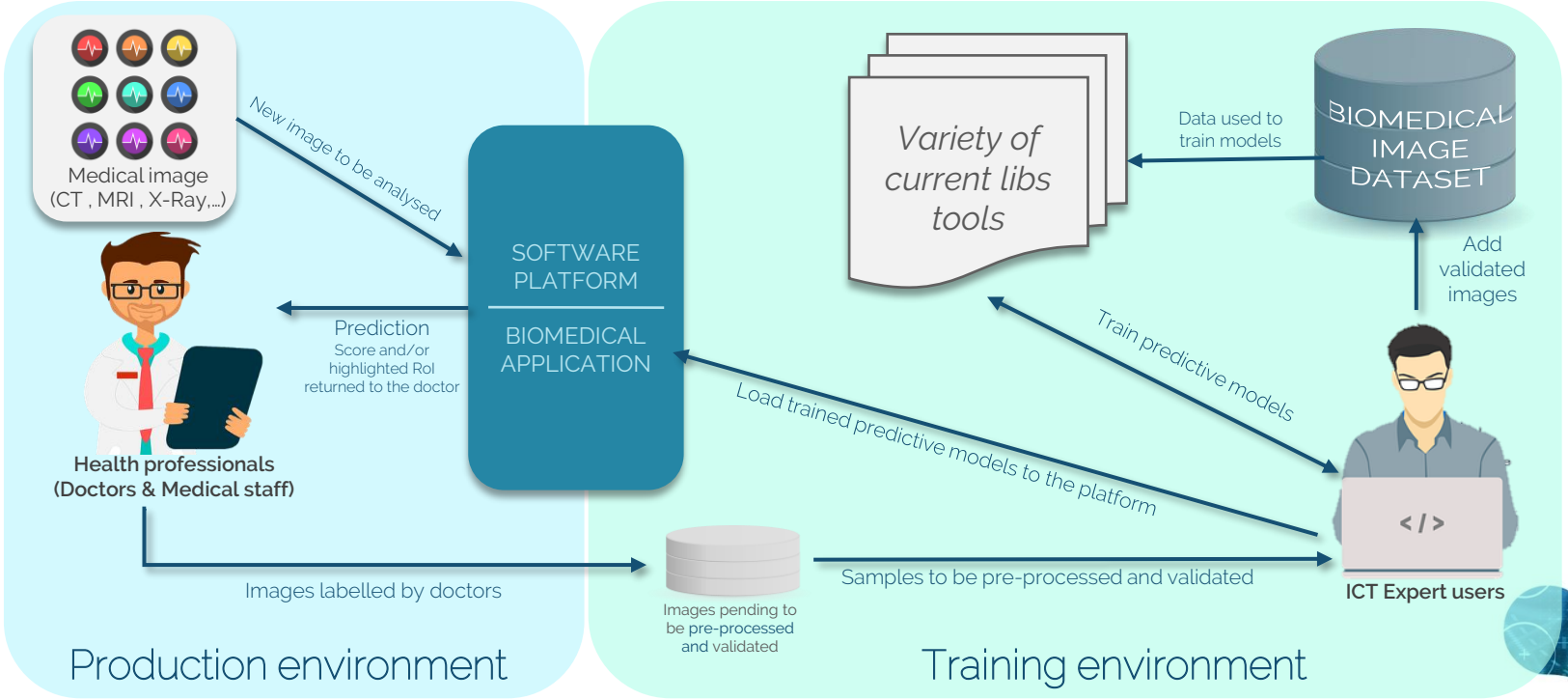
The scenario



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Aim & Goals

- **Put High Performance Computing power at the service of biomedical applications** with DL needs and, through an interdisciplinary approach, apply DL techniques on large and complex image biomedical datasets to support **new and more efficient ways of diagnosis, monitoring and treatment of diseases**.

- Work towards reducing the gap between the availability of cutting-edge technologies and its extensive use for medical imaging

- Facilitate the daily work and **increase the productivity** of medical personnel and IT professionals in terms of image processing and the **use of predictive models** without the need of combining numerous tools.

- Offer a **unified framework** adapted to exploit underlying heterogeneous **HPC and Big Data architectures** supporting state-of-the-art and next-generation DL (AI) and CV algorithms to enhance European-based medical software platforms.

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Developments & Expected Results

- **The DeepHealth toolkit**
  - Free and open-source software: 2 libraries + front-end.
    - ***EDDLL:*** *The European Distributed Deep Learning Library*
    - ***ECVL:*** *the European Computer Vision Library*
  - Ready to run algorithms on Hybrid HPC + Cloud architectures with heterogeneous hardware (Distributed versions of the training algorithms)
  - Ready to be integrated into end-user software platforms or applications
- **HPC infrastructure** for an efficient execution of the training algorithms which are computational intensive by making use of heterogeneous hardware in a transparent way
- Seven enhanced **biomedical and AI software platforms** provided by EVERIS, PHILIPS, THALES, UNITO, WINGS, CRS4 and CEA that integrate the DeepHealth libraries to improve their potential
- Proposal for a structure for anonymised and pseudonymised data lakes
- **Validation** in 14 use cases (*Neurological diseases, Tumor detection and early cancer prediction, Digital pathology and automated image annotation*).

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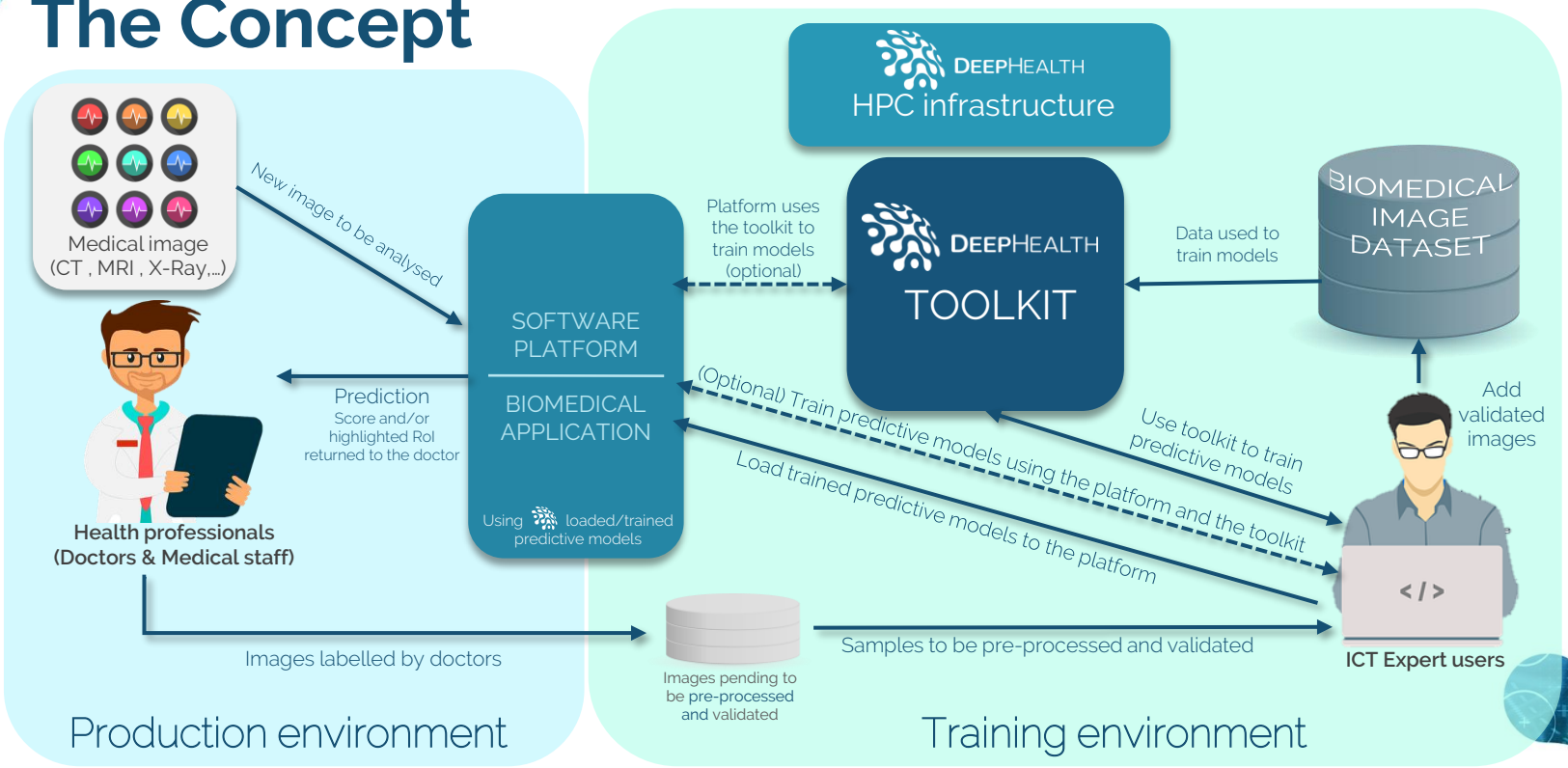
The Concept



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The Consortium

22 partners from 9 countries

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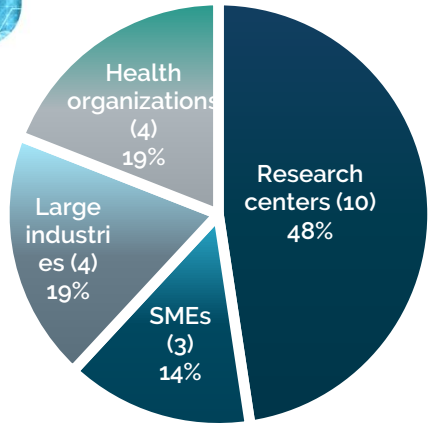

Research Organisations

UNIVERSITAT POLITÈCNICA DE VALÈNCIA
Barcelona Supercomputing Center Centro Nacional de Supercomputación
list
UNIMORE Università degli Studi di Modena e Reggio Emilia
Karolinska Institutet
CRS4 Ideas become life
Università degli Studi di Torino
Otto von Guericke Universität Magdeburg
EPFL

Health Organisations

Azienda Ospedaliero-Universitaria Città della Salute e della Scienza di Torino
Fundación para el Fomento de la Investigación Sanitaria y Biomédica de la Comunitat Valenciana
CHUV
Spitalul Clinic Prof. Dr. Theodor Burghele București
Stockholms läns landsting

Large Industries

NTT DATA
PHILIPS
THALES
SIMAVI Software Imagination & Vision

SMEs

WINGS ICT Solutions
TREE Technology
prodesign electronic gmbh
security Stelar tech law research

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Use Cases

14 pilot test-beds in 3 areas

Neurological diseases

- UC1. Migraine and Seizures prediction
- UC7. Major depression
- UC8. Dementia
- UC9. Study of structural changes in lumbar spine pathology
- UC10. Population model for Alzheimer's Disease
- UC13. Epileptic seizures detection
- UC14. Objective fatigue assessment for Multiple Sclerosis patients

Tumor detection and early cancer prediction

- UC4. Chest cancer detection
- UC6. Prostate tumor diagnosis
- UC12. Skin cancer melanoma detection

Digital pathology and automated image annotation

- UC2. Classification of whole-slide histological images of colorectal biopsy samples
- UC3. CT brain perfusion maps synthetization
- UC5. Deep Image Annotation
- UC11. Image Analysis and prediction for Urology

Pilots will allow to train models and evaluate the performance of the proposed solutions in terms of time and accuracy.

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Key Performance Indicators

- **time-of-pre-processing-images**
- **time-to-model-in-production**
- **time-to-train-models**

Measured in hours

- **Speedup**
- **Efficiency of parallelism**

For measuring the performance in training and predicting algorithms

- **Specific KPIs of use cases**

For measuring the performance of predictive models

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Expected Impact

- For IT experts:
  - Increase of **the productivity of IT staff** working in the health sector by allowing them to design, train and test many more predictive models in the same period of time
  - Facilitate IT experts work: ease of use/train Deep Neural Networks on HPC with no profound knowledge on Deep Learning, HPC, distributed or cloud computing.
- Health impact:
  - Increase early diagnosis and improving treatments
  - Extend the knowledge about diseases and pathologies
  - Save direct and indirect healthcare costs
- Beyond Health:
  - Outcomes useful to other sectors: EDDLL will be a general purpose Deep Learning Library, ECVL will be useful for image processing in general

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