RADIO, IASIS, BigMedilytics: Success stories in H2020 healthcare challenges

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PHC-19-2014 - Advancing active and healthy ageing with ICT: service robotics within assisted living environments
PM-18-2016: Big Data supporting Public Health policies
RADIO Basic Facts

• **Title:** Robots in assisted living environments: Unobtrusive, efficient, reliable and modular solutions for independent ageing

• **Topic:** PHC-19-2014 - Advancing active and healthy ageing with ICT: service robotics within assisted living environments

• **Contract No.:** 643892

• **Budget:** € 3.8M

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The RADIO Action and Concept

Advancing active and healthy ageing with ICT: Service robotics within assisted living environments

- Clinical monitoring for assessing ability to live independently alone
- No stigmatization
  - All monitoring hardware also assists at home
  - Robot finds and guides
  - Using home automation also provides monitoring data
- No functional obtrusiveness
  - Primary users are never asked to charge, use, wear, remember to do anything whatsoever to be monitored

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The RADIO System

• Home automation
  • Activities: using appliances to prepare meal, leaving home, watching TV
• Mini-rack with three Raspberry Pi’s
  • Off-board computations, prolonging robot’s battery autonomy
• The RADIO Robot
  • Motion analysis, audio analysis, object tracking in laser scans
  • Measurements: walking speed, bed transfer speed
  • Activities: medication intake

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The RADIO Ecosystem

- Privacy-preserving peer-to-peer distributed computation of statistics
  - Facilitates medical research over sensitive data
- Core conceptual infrastructure and algorithms existed
  - But were never worked into a full, implementable communications protocol
- We designed and implemented protocol and stack
  - Backend software for nodes and for “researcher” node
  - R library that hides RASSP details to provide statistical functions (t-test, average, etc.)
- In addition to usual access control
  - Health professionals see detailed reports about person they are responsible for

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iASiS Basic Facts

- **Title**: Integration and analysis of heterogeneous big data for precision medicine and suggested treatments for different types of patients
- **Topic**: H2020-SC1-PM-18-2016 - Big Data supporting Public Health policies
- **Contract No.**: 727658
- **Budget**: € 4.3M

Timeline:
- **April 1, 2017**
- **Sept. 30, 2018** Reporting
- **March 31, 2020** Reporting
Vision and Objectives

iASiS Vision:

Turn clinical, pharmacogenomics, and other Big Data into actionable knowledge for personalized medicine and health policy-making

iASiS Objectives:

• Integrate automated unstructured and structured data analysis, image analysis, and sequence analysis into a Big Data framework

• Use the iASiS framework to support personalized diagnosis and treatment
The iASiS Framework

- **iASiS analyzes:**
  - EHRs (English & Spanish)
  - MRI & PET/CT images
  - Genomic data (e.g. liquid biopsy samples)
  - Related bibliography (e.g. PubMed)
  - Biomedical databases (e.g. DrugBank)
  - Biomedical ontologies (e.g. GO, UMLS)
The iASiS Framework

- Extracted knowledge is fused in the iASiS knowledge graph
  - Unified semantic schema
  - Linked data
  - Machine-processable knowledge

- iASiS end-users can:
  - Perform natural language questions
  - Receive answers along with justifications
  - Identify patterns in patient populations
  - Make informed decisions

- All steps of data management and analytics enforce privacy and access control
Lung Cancer Use case

Select treatment for long survival

Input: patient data

Output

Patient categorization into survival groups

Treatment Recommendation

Analysis

online

offline

Input:
patient data

Output

Patient categorization into survival groups

Treatment Recommendation
Alzheimer’s Use case

Which drug is most suitable for a particular patient?

Input: patient data

Positive response estimates for each available drug

Output

Drug Recommendation

online

offline

Analysis
Current status: iASiS in numbers

- Electronic health records: 7,146 reports, 171,878 clinical notes, 706 patients (LC)

- Open data: 266,170 articles (LC & AD), 168,831 concepts, 1,001,180 extracted relations

- Genomic data: 20,778 proteins x 98,608 RNAs interaction network

→ Knowledge graph: 231,693,984 triples
Beyond Data Analysis

• iASiS handles sensitive patient data from hospitals: EHRs, MRI and PET/CT images, blood and liquid biopsy samples

• Ethics Committee led by external advisor to oversee the adherence to rules, regulations and patient consent per data source.

• Data management plan using FAIR principles and corresponding tools.

• Data access control, including anonymization, hardware and software protection, regulated access.
BigMedilytics aims to use state-of-the-art Big Data technologies in order to improve the productivity of the Healthcare sector by reducing cost to the patient, improving quality through better patient outcomes and delivering better access.
Percentage of deaths from non-communicable diseases in Europe

BigMedilytics covers *all* the major disease groups in Europe which cause 78% of the deaths:

- Cardiovascular disease
- Cancer
  - Breast cancer
  - Lung cancer
  - Prostate cancer
- Chronic respiratory disease
- Diabetes
- Kidney disease
- Comorbidities
Challenges: Technical/Non-technical

Enabling collaborative innovation across all key players in the Healthcare and Data Value Chains
• Patients
• Healthcare Providers
• Payers
• Vendors (Medical diagnostics and Services, Pharmaceuticals, HealthcareIT)
• Knowledge Institutions
12 pilots across 3 themes

BigMedilytics Pilots

Population Health & Chronic Disease Management
WP2 Leader: Incliva

Oncology
WP3 Leader: Philips

Industrializing Healthcare Services
WP4 Leader: Philips

1. Comorbidities
Pilot Leader: Incliva
Location: ES

2. Kidney disease
Pilot Leader: Charite
Location: DE

3. Diabetes
Pilot Leader: Huawei
Location: IE

4. COPD/Asthma
Pilot Leader: Southampton
Location: UK

5. Heart Failure
Pilot Leader: EMC
Location: NL

6. Prostate cancer
Pilot Leader: Philips
Location: SE

7. Lung cancer
Pilot Leader: Demokritos
Location: ES

8. Breast cancer
Pilot Leader: IBM
Location: FR

9. Stroke
Pilot Leader: ETZ
Location: NL

10. Sepsis
Pilot Leader: Incliva
Location: ES

11. Asset Management
Pilot Leader: OLVG
Location: NL

12. Radiology Workflows
Pilot Leader: ContextFlow
Location: AT
Lung cancer pilot: big data approach

**Big Data**

Patient data
- Electronic Health Records
- Call center logs
- Mobile app logs

Open Data
- Publications
- Databases
- Ontologies

**Artificial Intelligence**

Data Analysis
- Text mining
- Statistical learning

Data Integration
- Knowledge graph
- Meta-analysis

**Precision Medicine**

- Improved risk stratification
- Discovery of potential toxicities
- Explanation of adverse effects
How to create success stories

- Start early – a good proposal needs time and evolution

- Clear unique project objective

- Form the Consortium:
  - Clear unique (set of) target group(s)
  - Clear set of partners – are they THE voice of the market?

- Make sure you know the current (market) situation and your starting point
  - Check the list of H2020 current projects
All three sections are equally important:

• **Excellence:**
  • Focus and show **how you innovate**
  • Explain the **overall concept** underpinning the project

• **Impact:**
  • **Quantify!** Describe in a concise, yet robust, manner your baseline, benchmarks and assumptions
  • Plan activities to monitor your performance

• **Implementation:**
  • Take your time to decide **the best methodology to be applied** – can it deliver?
How to create success stories

• Design your budget “bottom-up”:
  1. define tasks
  2. Estimate efforts needed (person man-months of work)
  3. Translate person-months into EUR

• Ethics, privacy-legal issues
  • Advisory board
  • External Ethics/legal advisors
Thank you for your attention

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