Imagine 2029: Our data, our health, our care – 20th anniversary of EHTEL

EHTEL 2019 Symposium

16:30 – 17:45 [S5]

**AI as a Trustful Enabler for Better Health and Better Care** - concluded by a Debate

More use cases and insights on betterment of health and care enabled by artificial intelligence.

Session Chair: Matteo Mellideo, Engineering, Rome, Italy

**Use Cases enabled by High Performance Artificial Intelligence**
Ulises Cortés, Barcelona Supercomputing Center, Barcelona, Spain

**DMCoach+: A Digital Coach to Enhance the Self-Management of Diabetic Patients**
Roberto Pratola, DMCoach and Engineering, Rome, Italy

**AI-enabled Social Robots: Artificial Intelligence in Direct Interaction**
Joao Quintas, Istituto Pedro Nunes and LifeBots Project, Coimbra, Portugal

**Q&A - Panel Debate with the Audience**
Moderator: Diane Whitehouse, EHTEL
A case study of telehealth applied on Type 2 Diabetes Management
Fact and Figures

58 mln
diabetics
age range 20-79
87-91% type 2

Diabetes-related healthcare expenditure in Europe

€140 bil

Source: IDF Diabetes ATLAS 2017
Our aims

- Prevent T2DM & its exacerbation and the onset of RELATED DISEASES Such as CVD, kidney, etc.
- Reduce RISK FACTORS as overweight and unhealthy lifestyles
- Optimise TREATMENT COSTS of healthcare providers
- WELFARE COSTS of companies and payors
- Increase citizens/patients EMPOWERMENT and awareness
- Increase citizens/patients EMPOWERMENT and awareness
- Welfare costs of companies and payors
- Increase citizens/patients awareness
Study Objective

Evaluate the **perception of** and the **engagement on**, of both patients with Type 2 Diabetes Mellitus and people at-risk-of, a **AI enriched digital coach** to prevent and manage the disease.
Involved users

**Doctors** have been involved to *tailor* the solution

**Patients** and **People at risk** have been involved
The process

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Context: Healthcare</td>
<td>• Context: Workplace Health Promotion</td>
<td>(ongoing)</td>
</tr>
<tr>
<td>• elderly (60+) patients with T2DM</td>
<td>• people at risk</td>
<td></td>
</tr>
<tr>
<td>• diabetologists</td>
<td>• occupational doctors</td>
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</table>
**Active ratio of users (tot: 185)**

32 patients (Hospitals)

153 citizens at-risk-of (Workplaces)

*Active ratio (%) = active days / total observation days*
Overall Results

- In the first phase (with patients) the doctors’ interventions have been more than the latter (with people at risk) thus a reduction of the adherence has been observed.
  - The involvement of the practitioners (when low interactions have been observed) has been partially compensated by the social challenges
- The more users felt involved in the solution, the more they adhered to doctors’s directions
What the final users liked

- the tool itself increases the positive perception on the healthcare institution/company (perceived as innovative and “near” to them)
- the nutrition diary support their everyday life
- educational seen as practical pills
- data was shared only with doctors through a secure platform
- personalized coaching messages (automatic based on AI) was considered reliable (as the doctors enabled the app)
How it works?
A solution managing Type 2 Diabetes Mellitus and preventing chronic diseases.

- provides **coaching** and **advices** towards healthy lifestyles
- enabled by doctors (*human touch*) who tailor the solution **on the specific needs of the users** and coach them keeping them **engaged** and **motivated**
- implements **Trans-Theoretical Model** *(AI-based approach)*
- includes **gamification techniques** to create **social challenges** on health

*Prochaska et al., 1994, 2002; Prochaska and Velicer, 1997*
DMCoach+

- doctors easily tailor the app defining goals (and challenges)
- patients/users comply with the goals and get automatic feedback
- adaptive feedback on users' behaviours
- doctors monitor performance and send personalized feedback (Human touch)
What can be expected?
when interacting with digital coaches
... from doctors?

- Willingness to **support** patients
  - as to reduce the frequency of encounters
- **Remote coaching** of patients
  - often enabled by specialized nurses
- Interaction with (selected) patients to **motivate** them or **improve** their behaviours
... and from patients?

- Willingness to change behaviours
- Perseverance and engagement
  - as long as the human touch is perceived
- No propensity to lie (while tracking habits)
THANK YOU

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Researcher

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Intelligent Artificial Social Companions: European case studies and future directions

The annual EHTEL Symposium
Collaborating for Digital Health and Care in Europe

Barcelona, 3 December 2019
Artificial Social Companions in AAL
Variety of open scientific and technological challenges related with HMI/HCI/HRI but …

… There is still a lack of standardization in Robotics and Automation (R&A) field in terms of the way some core components are implemented

Based on needs and requirements of:
Problem

... after sometime interacting with the system, passed the novelty effect, we observed, [...] a decrease in acceptance. The most reported reason was that the agent did not fully reach users’ original expectations.

“Participants easily got frustrated after a few unexpected verbal behaviour by the agent.”
Artificial Social Companions in AAL
CaMeLi and CogniViTra (AAL projects)
Artificial Social Companions in AAL
GrowMeUp H2020 project

An affordable service robot to support and stimulate older adults in daily activities at home.

A robot based collaborative care network connects the older adult with family, friends and care personnel.

The robot learns from interacting with and observing older adults and adapts its service to their habits, preferences and routines.

Scalable and adaptable architecture with automatic detection of external devices that extend service capabilities.

A cloud structure supports information exchange between Service Robots allowing them to autonomously enhance and adapt their services and abilities.

Enhanced Human-Robot Interaction based on natural multilingual dialogue, allows older adults to teach their robots and receive personalized assistance.

The robot is equipped with a set of different sensor technologies allowing it to perceive the environment and offer functionalities to support daily life activities at home.

Artificial Social Companions in AAL
Application scenario

Based on needs and requirements of:
Context-Aware Human-Robot Interaction Framework

Knowledge representation


Currently cooperating with IEEE AuR working group for developing standard IEEE 1872.2
CAHRI Framework
Application scenario – Describing scenario ontology


http://www.contextawarerobotics.org/cahri/kr/im-cahri.owl
CAHRI Framework
Application scenario – Feature description & implementation

1. List algorithms for person detection

2. Test more promising algorithms in benchmarking datasets (e.g. INRIA dataset for people detection)

3. Define decision process model to obtain interaction policies
   (POMDP tool by Anthony R. Cassandra’s in pomdp.org)

4. Complete scenario description

5. Use in Execution Level

\[ \{S, A, O, \Omega, T, R\} \]

\[ S = \{s_0 = \text{person detected}, s_1 = \text{person not detected}\} \]

\[ A = \{a_0 = \text{haar detection}, a_1 = \text{hog detection}, a_2 = \text{check light}\} \]

\[ O = \{o_0 = \text{dark light}, o_1 = \text{good light}, o_2 = \text{bright light}\} \]

\[ T_{a_0} = \begin{bmatrix} s_0, s_0 & s_0, s_1 & s_1, s_0 & s_1, s_1 \\ s_0, s_0 & s_0, s_1 & s_1, s_0 & s_1, s_1 \end{bmatrix} = \begin{bmatrix} 0.9 & 0.1 \\ 0.9 & 0.1 \end{bmatrix} \]

\[ T_{a_1} = \begin{bmatrix} s_0, s_0 & s_0, s_1 & s_1, s_0 & s_1, s_1 \\ s_0, s_0 & s_0, s_1 & s_1, s_0 & s_1, s_1 \end{bmatrix} = \begin{bmatrix} 0.9 & 0.1 \\ 0.9 & 0.1 \end{bmatrix} \]

\[ T_{a_2} = \begin{bmatrix} s_0, s_0 & s_0, s_1 & s_1, s_0 & s_1, s_1 \\ s_0, s_0 & s_0, s_1 & s_1, s_0 & s_1, s_1 \end{bmatrix} = \begin{bmatrix} 1.0 & 0.0 \\ 0.0 & 1.0 \end{bmatrix} \]

\[ O_{a_0} = \begin{bmatrix} s_0, o_0 & s_0, o_1 & s_0, o_2 \\ s_1, o_0 & s_1, o_1 & s_1, o_2 \end{bmatrix} = \begin{bmatrix} 0.494 & 0.402 & 0.104 \\ 0.388 & 0.418 & 0.194 \end{bmatrix} \]

\[ O_{a_1} = \begin{bmatrix} s_0, o_0 & s_0, o_1 & s_0, o_2 \\ s_1, o_0 & s_1, o_1 & s_1, o_2 \end{bmatrix} = \begin{bmatrix} 0.450 & 0.435 & 0.115 \\ 0.395 & 0.395 & 0.210 \end{bmatrix} \]

\[ O_{a_2} = \begin{bmatrix} s_0, o_0 & s_0, o_1 & s_0, o_2 \\ s_1, o_0 & s_1, o_1 & s_1, o_2 \end{bmatrix} = \begin{bmatrix} 0.000 & 0.500 & 0.500 \\ 0.000 & 0.500 & 0.500 \end{bmatrix} \]

\[ R(s_0, a_0, s', o) = 20 \quad R(s_1, a_0, s', o) = -100 \]

\[ R(s_0, a_1, s', o) = 20 \quad R(s_1, a_1, s', o) = -100 \]

\[ R(s, a_2, s', o) = -5 \]

\[ \pi^*(b) = \arg\max_{a \in A} \left[ r(b, a) + \sum_{o \in O} P(o|b, a) V^*(b') \right] \]

3. Define decision process model to obtain interaction policies
CAHRI Framework
Application scenario – Results

CAHRI Framework
Application scenario – Results

Luminance (lux)

Frames

lightObs

Actions
- hog
- check-light

Observations
- dark-light True Positive/Negative
- normal-light False Positive
- haar False Negative

Features
- DP
- Haar
- Hog

IEEE1872.2 Working Group to develop standards for autonomous robotics

General concepts and domain-specific axioms for autonomous robotics; and

Using developed vocabularies and ontology for conceptual design of autonomous robotic applications and general use cases and/or case studies for autonomous robotics.
Knowledge needed to build autonomous systems comprised of robots that can operate in all classes of unstructured environments.

Allows for unambiguous identification of the basic hardware and software components necessary to provide a robot, or a group of robots, with autonomy.

“... an ontology is a description [...] of the concepts and relationships that can exist for an agent or a community of agents. ....“

Tom Gruber

Toward standardization
European supporting activities

Supporting European Experts Contribution To International ICT Standardisation Activities

StandICT.eu is a new initiative funded by the European Commission focused on supporting the participation and contribution of EU Specialists to SDO and SSO activities covering the 5 essential building blocks of the digital Single Market: 5G, Cloud Computing, Cybersecurity, Big Data and IoT.

Read More About The 8th StandICT.Eu Open Call!
Toward standardization
European supporting activities

StandICT.eu
Supporting European Experts Presence in International Standardisation Activities in ICT

8 OPEN CALLS
RESULTS & POPULAR TOPICS

258 FUNDED APPLICATIONS
500 ELIGIBLE APPLICATIONS RECEIVED

25 EUROPEAN COUNTRIES
95 → ONE SHOT
130 → SHORT TERM
275 → LONG TERM

MOST TARGETED TOPICS
5% → AI
4% → BLOCKCHAIN
3% → CLOUD COMPUTING
30% → CYBERSECURITY
22% → BIG DATA
7% → 5G
11% → IoT
17% → Other

https://www.standict.eu/
Undergoing work for strengthening the network of Social Robotics experts

- **LIFEBOTS Exchange** seek to:
  - develop a holistic understanding of social robots in the intersection of care, user interaction, technology and society;
  - Researcher and staff exchange;
  - Increase knowledge on social robotics;
  - Increase cooperation between different disciplines, sectors and countries
Conclusion

• Developing solution for the **Intelligent Artificial Social Companions** involve a multidisciplinary approach and it entails a variety of open scientific and technological challenges but … There is still a lack of standardization in Robotics and Automation (R&A) field in terms of the way some core components are implemented (including AI).

• The field needs more real application scenarios demonstrating the possibilities of such technologies but … Still requires adaptation and improved robustness to provide services specifically designed for the user in order to enhance their everyday life and be provided with high-quality healthcare services.

• In the future, great developments adoption and promotion of a more standardized development and multidisciplinary collaboration with relevant European research and innovation networks (e.g. LIFEBOTS Exchange, Digital Innovation Hubs for Robotics).
Thank you!

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