REACH: Responsive Engagement of the Elderly promoting Activity and Customized Healthcare

Thomas Bock Dr.-Ing./Univ. Tokio[a,*]

[a]Chair of Building Realisation and Robotics, Technical University of Munich, Germany; *Corresponding author: thomas.bock@br2.ar.tum.de

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REACH is a multi-disciplinary, multi-partner EU funded research project that develops within a four-year project duration the next generation of technologies and services for a future value-based and prevention-oriented health care system. Research partners form the scientific backbone of the consortium; industry partners take on various roles from sensor development, rehabilitation equipment integration, to ICT platform deployment and business model and standardization support; use case partners state exemplary care settings and application scenarios for the real-world deployment of the innovations developed in REACH. This special issue of Gerontechnology gives an overview over the scientific achievements of the first project year covering a diversity of areas ranging from user co-creation approaches, the determination of design requirements, systems engineering approaches to personalized persuasive strategies, approaches regarding privacy and safety, and initial sensor and device development and testing, to standardization, innovation management, and business model aspects.

Keywords: preventive health care technology, monitoring, motivational techniques, smart environments

Scientific goal and consortium

In the REACH project (http://reach2020.eu/), a sensing-monitoring-intervention system is developed that can be placed in an unobtrusive manner in various care settings and living environments of elderly citizens. The system will be able to: (1) use a set of sensors to detect selected vital signs, behavioral/care patterns, and health states; (2) predict–as early as possible–future health states, risks or events (loss of function, frailty, stroke, etc.); and (3) provide and coordinate proactively a set of customized services and products that have the overall aim at stimulating and supporting physical activities. Early intervention by REACH should allow for the time spent in a desirable health state (baseline health), and Healthy Life Years (HLYs) to be increased, and that the time spent in Long-Term Care (LTC) facilities is reduced. In that context, it will be shown that REACH can improve and speed up, on one hand, the physical and cognitive rehabilitation of elderly citizens in deteriorated health states or suffering from a sudden incident, for example, by speeding up their transfer from acute care to rehabilitation to home care, as well as their health state improvement within one of these institutions. On the other hand, it will be demonstrated that REACH can be utilized in home/home care contexts for as long as possible to keep people in a desired base-line health state, mitigate the risk of deterioration, and finally slow down or prevent deterioration.

The proposal for this project was developed in 2015 and submitted under pillar 3 of H2020 in societal challenge 1 Personalized Healthcare (PHC). In the European consortium with 17 partners from higher education institutions and industry, form a full value chain for the development, testing, and provision of technology based, preventive health care services. The 6 research partners (TU München–project coordinator, TU Eindhoven, École Polytechnique Fédérale of Lausanne, Technical University of Denmark, University of Kopenhagen, and Fraunhofer IAIS) for the scientific backbone of the consortium. 7 industry partners (Philips, Biozoon, Sturrm, SmartCardia, Alreh Medical, DIN, ArjoHuntleigh) take on various roles from sensor development, rehabilitation equipment integration, to ICT platform deployment, and business model and standardization support. 4 use case partners (Schön Klinik, Geneva Hospital, Zuid-Zorg, Lyngby-Taerbeken Kommune) state exemplary care settings and application scenarios for the real world deployment of the innovations developed in REACH.

Touchpoints and Engine concept: smart furniture

Stating a key achievement of the first project year, the REACH consortium has developed and detailed a holistic conceptual solution, the 'Touchpoints and Engine concept', based on an in-depth analysis of the four REACH use case settings, and the identification and inclusion of consortium

internal and consortium external stakeholders (elderly, care personnel, insurances, etc.) in the system architecture development process. This conceptual solution fully reflects REACH's 'Product-Service-System' value proposition. 5 physical touchpoints will function each as data gathering and intervention devices, which are bound together by cross-sectional, integrated engine (i.e. platform) functionality (*Table 1*).

'Touchpoints' will act as 'graspable' front end towards the end users (elderly). Touchpoints will mainly materialize as 'furniture' in a broader sense, i.e. elements that can be placed and moved within a certain environment or setting (e.g. beds, bath furniture, mobile walkers/standers, large scale interfaces, smart flooring tiles, smart tables, etc.) but also as ambient sensor add-on modules and wearables. The Touchpoints will serve as data gathering devices as well as mediator of services and interventions coordinated by the Engine towards the end user. Each Touchpoint is modular in itself (thus also serving as a kind of physical product platform) and made up of several subsystems which allow to adapt the system both for a certain person or setting as well as over time. The 'Engine' ICT platform-in itself also modular with regard to its functionality–serves from the viewpoint of the end user as 'invisible' back end system. In general, the end users (elderly) are supposed to interact with the 'engine' primarily in an indirect way through the Touchpoints.

REACH's Human-System interaction approach

A number of core functional elements of REACH were identified as part of various REACH activities: measure, monitor, promote and activate (*Figure 1*). The service blue print concept sets these four elements into relation to each other and uses them to create a feedback loop that shall govern the interaction between end users and the REACH system via the Touchpoints. REACH should on one hand, continuously measure the user activities in the front end, while at the back-end monitor the processes and identify/predict acute events and unusual patterns for potential activations by the system or caregivers at the front-end experience of the user again. The service blue print concept can be used to govern the implementation of the REACH human-system interface between the end-users and the Touchpoints.

Data Analytics, Privacy, and Data Management

The collection and processing of personal lifestyle and health data (through physical 'Touchpoints') and their utilization (early detection and intervention, aggregation, analysis, sharing, feedback, services, etc.) play a major role in REACH. Therefore, the REACH Data Management foresees, amongst others, that the underlying data sets produced and/or utilized will be categorized into data categories which are assigned to different security levels. The Data Management approach will be exercised within REACH to develop further and prepare commer-

Table 1. Outline of REACH's Touchpoint and Engine concept

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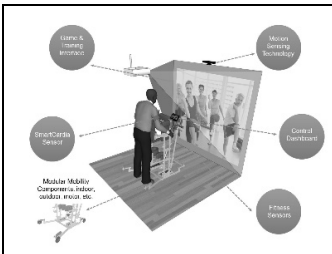
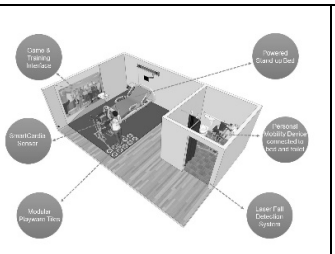
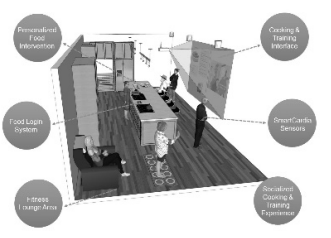
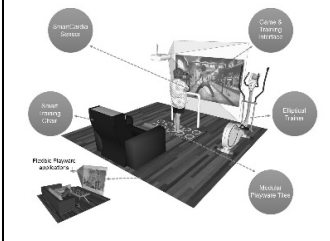
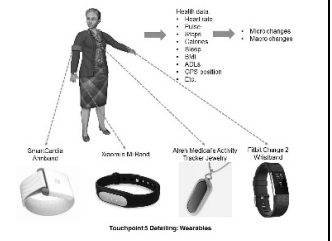
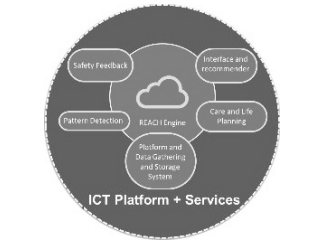
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Touchpoint 1: Personal Mobility Device</td><td>Touchpoint 2: Active Environment</td><td>Touchpoint 3: Socializing & Nutritional Intervention</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Touchpoint 4: Gaming & Training</td><td>Touchpoint 5: Wearables</td><td>Engine</td></tr>
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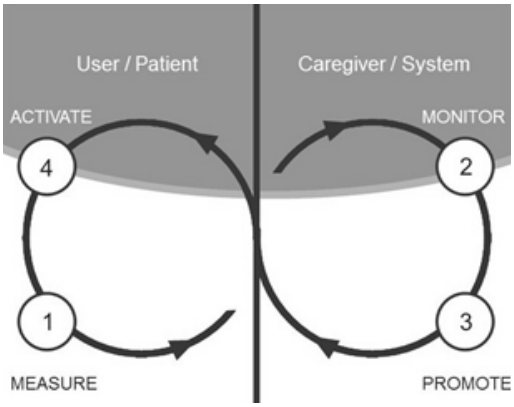

Figure 1. REACH core components of the 'service blueprint' that shall govern the interaction between end users and the REACH system via the Touchpoints (Image: Philips)

cial exploitation of REACH data beyond the project. In parallel mechanisms will be developed that ensure customer acceptance of health data aggregation through implementation and communication of appropriate ethics, privacy and data management strategies. Based on testing involving users, Touchpoints, and data gathered, a lifestyle recommender system is developed to help senior adults with sedentary habits to become more active using the REACH Touchpoints. In that context methods are developed to cluster existing users based on how a given intervention of behaviour change affects their current habits modelled as time series data (*Figure 2*).

Conclusion

REACH is a multi-disciplinary, multi-partner EU funded research project, that develops within a four-year project duration the next generation of technologies and services for a future value-based and prevention-oriented health care system. Research partners form the scientific backbone of the consortium; industry partners take on various roles from sensor development, rehabilitation equipment integration, to ICT platform deployment and business model and standardization support; use case partners state exemplary care settings and application scenarios for the real-world deployment of the innovations developed in REACH. This special issue of Gerontechnology gives an overview over the scientific achievements of the first project year covering a diversity of areas ranging from user co-creation approaches, the determination of design requirements, systems engineering approaches to personalized persuasive strategies, approaches regarding privacy and safety, and initial sensor and device development and testing, to standardization, innovation management, and business model aspects.

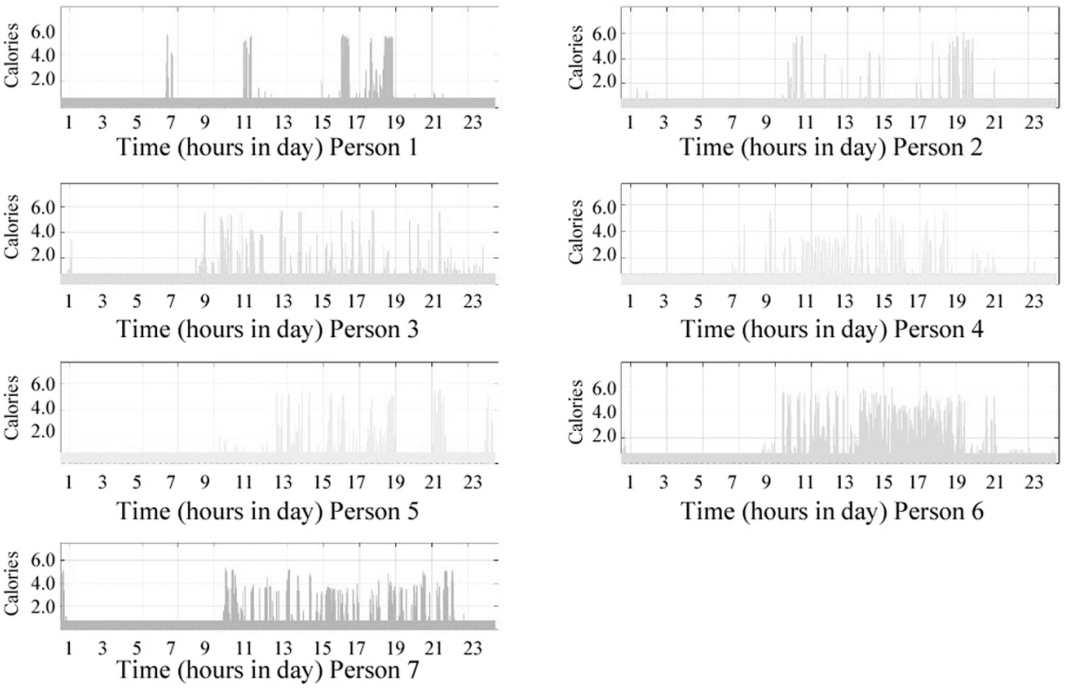

Figure 2. The cluster prototypes for the HealthyTogether Dataset (Image based on: Yürüten O, Zhang J, & Pu P; 2014, June. Decomposing activities of daily living to discover routine clusters. In Twenty-Eighth AAAI Conference on Artificial Intelligence)

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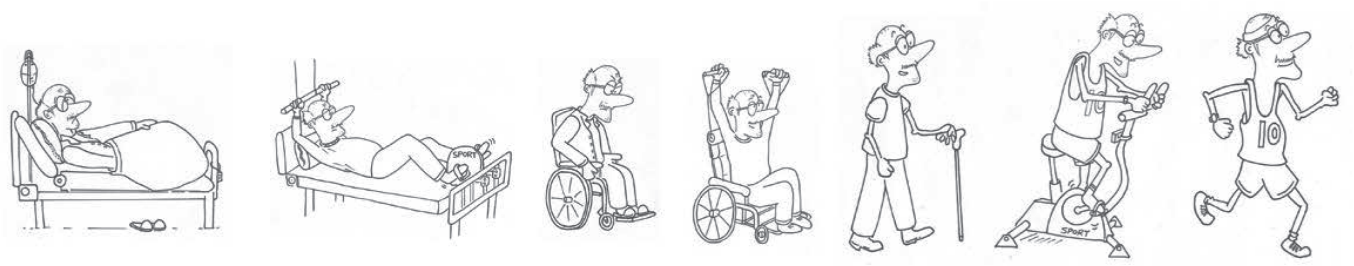

Research

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Technical University of Denmark

TU/e Technische Universiteit Eindhoven University of Technology

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