

EMPATHIC: Empathic, Expressive, Advanced Virtual Coach to Improve Independent Healthy-Life-Years of the Elderly

EMPATHIC: Coach virtual empático, expresivo y avanzado para mejorar el bienestar de las personas de edad avanzada sanas e independientes

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Abstract: The EMPATHIC project will research, innovate, explore and validate new paradigms and platforms, laying the foundation for future generations of Personalised Virtual Coaches to assist elderly people living independently at and around their home. Innovative multimodal face analytics, adaptive spoken dialogue systems and natural language interfaces are part of what the project will research and innovate, in order to help dependent aging persons and their carers. The project will use remote non-intrusive technologies to extract physiological markers of emotional states in real-time for online adaptive responses of the coach, and advance holistic modelling of behavioural, computational, physical and social aspects of a personalised expressive virtual coach. It will develop causal models of coach-user interactional exchanges that engage elders in emotionally believable interactions keeping off loneliness, sustaining health status, enhancing quality of life and simplifying access to future telecare services

Keywords: Multimodal dialogue systems, virtual coach

Resumen: El proyecto EMPATHIC tiene como misión investigar, explorar, innovar y validar nuevos paradigmas y plataformas, sentando las bases para las futuras generaciones de *coach* virtuales personalizados para ayudar a personas de avanzada edad que viven de forma independiente en su hogar. Además, EMPATHIC investigará e innovará con el objetivo de ayudar a las personas de avanzada edad dependientes y a sus cuidadores mediante análisis facial multimodal, sistemas de diálogo adaptables e interfaces de lenguaje natural. El proyecto utilizará tecnologías remotas no intrusivas para extraer marcadores fisiológicos de estados emocionales en tiempo real, las cuales influenciarán el comportamiento del coach. También se modelarán los aspectos computacionales, físicos y sociales de los coach virtuales expresivos desde un punto de vista holístico. Finalmente, se desarrollarán modelos que permitan la interacción entre el coach y el usuario, buscando así involucrar a éstos en interacciones que contribuyan a evitar la soledad, mantener el estado de salud, mejorar la calidad de vida y simplificar el acceso a futuros servicios de teleasistencia.

Palabras clave: Sistemas de diálogo multimodal, asistente virtual

1 *Project Founding and Consortium*

The EMPATHIC project has been founded by the European Commission H2020-SC1-2017-RIA grant number 769872: “*Empathic, Expressive, Advanced Virtual Coach to Improve Independent Healthy-Life-Years of the Elderly*”.

The consortium brings together 10 partners from 7 EU and associated countries (Norway and Israel). Among these partners, we find 4 universities or research centres, 3 healthcare centres related to institutions, and 3 companies. The organisations involved are:

- Universidad del País Vasco UPV/EHU (coordinator).
- OSATEK S.A.
- Oslo University Hospital.
- e-Seniors Association.
- Tunstall Healthcare (UK) Ltd.
- Technion - Israel Institute of Technology.
- Intelligent Voice Ltd.
- Acapela Group S.A.
- Institut Mines-Télécom.
- Seconda Università degli Studi di Napoli.

2 *Introduction*

Without undermining the important degree of development that public healthcare services in Europe have achieved, in terms of coverage and intensity, much care for people with limitations in autonomy is still provided in the private sector of the family, i.e. informal care. According to the Survey of Health, Age and Retirement in Europe (SHARE, 2002 - 2004), more than seven out of ten dependent elderly people in Italy, Germany, and Sweden receive informal care exclusively. In Spain, Austria and Holland it is more than half. In Belgium, Denmark and France, despite more coverage of formal services, more than one third receive such informal care. It must be recognised that informal care for the family is unpaid work that provides economic savings to welfare systems. However, the predictions point to less availability of informal caregivers in the future. This situation has led European countries to become interested in policies to support the

informal care network, and caregiver support programs have become a priority area of action in the Union.

Studies suggest that attention to the lifestyle of the elderly can help them to maintain independent life (Willcox, Scapagnini, and Willcox, 2014a) (Davies, 2011). However, elder psychological obstacle, lack of knowledge and interpersonal and structural obstacles make it difficult for them. Therefore, besides promoting a healthy lifestyle, attention should be paid to the internal and external difficulties of the elderly through facilities and arrangement of activities. Here, virtual coaching is a very interesting solution (Ding et al., 2010) (Prescott et al., 2012) (Cavanagh and Millings, 2013).

Virtual Coach refers to a coaching program or device aiming to guide users through tasks for the purpose of prompting positive behaviour or assisting with learning new skills. Virtual coaches monitor how the user performs activities, provides situational awareness and gives feedback and encouragement matched to their cognitive state and circumstances at the same time. Further, a virtual coach matches its level of support to the user as his/her abilities change, and so the user can upload new options to the virtual coach as desired, and can define new well-being goals without even an office visit.

EMPATHIC will offer a personalised virtual coaching program in three languages (Spanish, French and Norwegian), ranging from low to high intensity levels. Such increased physical activity will help to decrease stress and depressive symptoms, and increase satisfaction with body function. An intervention to improve fruit and vegetable consumption based on the Dietary Guidelines for elders, and a review of practices, will also be applied, since proper nutrition plays a vital role in the health and wellbeing of older adults (Knoops et al., 2004) (Willcox, Scapagnini, and Willcox, 2014b). EMPATHIC will also offer coaching to focus on brief behavioural techniques like social activation and pleasant event planning.

EMPATHIC will cater to healthy people of 65 years or more, and virtually coach them in order to help increase the years of independent active living and to improve health and slower deterioration. Contact with nature will be encouraged. Recommendations will include also healthy food (and shopping),

having enough sun exposure, vegetables and protein intakes. All counselling will be given in a positive, optimistic manner. The device will include also social activities information, like films, operas, theatres, and conferences in their city.

To this end, this project will develop innovative multimodal face and speech analytics, adaptive spoken dialogue systems, intelligent computational models and natural human-computer interfaces, resulting in an emotionally-expressive virtual coach, designed to help aging users and their carers. Building upon neuroscience research, the project will use unobtrusive remote technologies to extract physiological markers of emotional states in real-time. The virtual coach will monitor facial cues and speech style that underpin the user's basic neural function, and will formulate online adaptive responses, facilitating interaction through mimicking, in turn promoting empathy and support with the user.

3 *EMPATHIC objectives*

3.1 Multidisciplinary research

EMPATHIC proposes multidisciplinary research and development, involving:

- Geriatrician, Neuroscientist, Psychiatric, health and social work specialists to implement the individual coaching goals.
- Psychologist, Neuroscientist and Computer Science experts for detection and identification of the emotional status of the user.
- Engineers and Computer Scientists in speech and language technologies, biometrics, image analysis, and machine learning.
- Telecare services, a senior association and a hospital interested in testing and validating EMPATHIC.
- Companies interested in providing and developing technology for the project and commercialising the products and derived services.

3.2 Main objectives

The six main objectives of this multidisciplinary research are listed next:

- Design a virtual coach, to engage the healthy-senior user and reach pre-set benefits, measured through project-defined metrics, to enhance well-being through awareness of personal physical status, by improving diet and nutritional habits, by developing more physical exercise and by social activity.
- Involve end-users and to reach a degree of fit to their personalised needs and requirements, derived by the coach, which will enhance their well-being.
- Supply the coach with non-intrusive, privacy-preserving, empathic, expressive interaction technologies.
- Validate the coach efficiency and effectiveness across 3 distinct European societies (Norway, Spain, and France), with 200 to 250 subjects who will be involved from the start.
- Evaluate/validate the effectiveness of EMPATHIC designs against relevant user's personalised acceptance and affordance criteria (such as the ability to adapt to users' underlying mood) assessed through well defined Key Performance Indicators.
- Drive the developed methodology and tools to industry acceptance and open-source access identifying appropriate evaluation criteria to improve the "specification-capture-design implementation" software engineering process of implementing socially-centred ICT products.

3.2.1 Scientific goals and research actions

These six objectives will be accomplished through the following sets of goals and research/development actions:

- Implement health-coach goals and actions through an intelligent computational system, intelligent coach and spoken dialogue system adapted to users' intentions, emotions and context.
- Provide automatic personalised advice guidance (through the coach) having a direct impact in empowering elder users into a wide of advanced ICT keeping improving their quality of life and level

their independent independency living status of the people as the age.

- Identifying non-intrusive technologies to detect the individual's emotional and health status.
- Provide the virtual coach with a natural, empathic, personalised and expressive communication model.

3.2.2 Technological goals and actions

- Develop a simulated virtual coach and acquire an initial corpus of dialogues through a Wizard-of-Oz to fulfil the initial end-users and data requirements of the Scientific Goals.
- Integrate and provide a proof-of-concept of the technology running on different devices.
- Validation through Field trials in the aforementioned three languages.

3.2.3 Exploitation goals

- Define a plan for the exploitation of the results by the consortium as a whole and by particular partners.

Acknowledgements

This work has been founded by the European Commission H2020-SC1-2017-RIA grant number 769872: "Empathic, Expressive, Advanced Virtual Coach to Improve Independent Healthy-Life-Years of the Elderly".

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