



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

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### Abstract

The EMPATHIC Research & Innovation project researches, innovates, explores and validates 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.

The project uses remote non-intrusive technologies to extract physiological markers of emotional states in real-time for online adaptive responses of the coach, and advances holistic modelling of behavioural, computational, physical and social aspects of a personalised expressive virtual coach. It develops 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.

EMPATHIC proposes multidisciplinary research and development, involving:

- Geriatrician, Neuroscientist, Psychiatric, health and social work specialists, knowledgeable in age related conditions and the aims of a coaching program in maintaining independence, functional capacity, and monitoring physical, cognitive, mental and social well-being 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. They will develop tools to detect emotional cues, model users' emotional status, translate coaching plans into actions, user-adapt spoken dialogue and personalise talking agents

- 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

Through measurable end-user validation, to be performed in 3 different countries (Spain, Norway and France) with 3 distinct languages and cultures (plus English for R&D), the proposed methods and solutions will ensure usefulness, reliability, flexibility and robustness

**Index Terms:** speech recognition, natural language understanding, spoken dialog systems, human-computer interaction, natural language generation, text to speech conversion, emotional features from speech and language, emotional voice

### 1. Objectives

- **OBI1:** 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

- **OBI2:** 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
- **OBI3:** Supply the coach with Incorporate non-intrusive, privacy-preserving, empathic, expressive interaction technologies
- **OBI4:** 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
- **OBI5:** 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 the Key Performance Indicators (KPI) listed in Section 1.1.2
- **OBI6:** 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.

#### Scientific Goals (Sc) and Research Actions:

1. 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. EMPATHIC researches a) the identification and assessment of main cues related to physical, cognitive, mental and social well-being b) defining personalised, psychologically motivated and acceptable coach plans and strategies c) translating professional coach behaviour into actions of the Intelligent EMPATHIC-VC.
2. Identifying non-intrusive technologies to detect the individual's emotional and health status. of the person through non-intrusive technologies. EMPATHIC uses emotional information from eyes, face, speech and language to deliver a hypothesis of the user emotional status to assist decisions of the EMPATHIC-VC. In this framework, the research focus on the detection of sudden shifts in the user emotional status or emotional changes during a certain period of time: a) extraction of emotional features b) data-driven approaches for multimodal modelling combining emotional cues provided by each source c) identification of significant changes in individual behaviour.
3. Implement health-coach goals and actions through an intelligent computational system, intelligent coach and spoken dialogue system adapted to users' intentions, emotions and context. EMPATHIC researches a) Data-driven modelling of user and tasks; b) Machine learning for understanding the user; c) Learning policies and questionnaires to deal with coach goals; d) Statistical approaches for dialogue management driven by both user and Coach goals; e) Online learning for adaptation.
4. Provide the virtual coach with a natural, empathic, personalised and expressive communication model in a supportive manner to allow emotional bonds that result in engaged and effective relationships. EMPATHIC researches and develop, through early

and continuous interaction with the end-users, the technologies to consider individual user profile, including cultural facts and interaction history, the current emotional status of the user and the coach strategies at each decision of the dialogue manager, at each text generated by the Natural Language Generator, at each inflexion of the TTS and at each movement of the personalised visual agent.

#### Technological Goals (Tg) and Actions:

1. Develop a simulated virtual coach and acquire an initial corpus of dialogues. A set of annotated dialogues will be designed and obtained through a Wizard-of-Oz (WoZ) technology to fulfil the initial end-users and data requirements of Scientific Goals #2, #3 and #4.
2. Integrate and provide a proof-of-concept of the technology running on different devices
3. Validation through Field trials. EMPATHIC will test representative realistic use cases for different user profiles in three different countries

## 2. An example

*Virtual Coach:* So, Pablo, ¿Have you ever eaten consistently 2 or 3 pieces of fruit?

*User:* When my wife was healthier, she used to take care of buying the fruit. Thus it was easier for me to eat it.

*Virtual Coach:* And in any other time of your life?

*User:* Long time ago, when I lived alone, I used to take care of buying the fruit myself, and I ate it more frequently.

*Virtual Coach:* What does this information suggest to you about your objective of eating 2 or 3 pieces of fruit a day?

*User:* Well... That it's something that basically depends on me.

*Virtual Coach:* So, can you see anything you could do to get closer to your objective?

*User:* Uhhh... I should start thinking how I am going to organise when I am going to buy the fruit.



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