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# The NESTORE Project: Co-Designing a Virtual Coach with Older Adults

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## Abstract

This paper presents the design process of the NESTORE system: a virtual coach for promoting healthy lifestyles in older age. The NESTORE system aims at putting the user at the core of the design process in order to address one of the biggest challenges of our century: “how to develop technologies that are actually useful and usable for the target users?”. In particular, this paper focuses on the design of the system interfaces and coaching strategies and presents the co-design process used for informing technologists on the user’s needs and desires.

## Author Keywords

NESTORE; virtual coach; older adults; co-design; healthy lifestyles.

## ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## Introduction

The ageing of the population is often seen as an economic threat by most countries, causing inevitable imbalance between people working and people potentially in need of care. According to an EU study [1], in 2060, for each person aged 65+ there will be only two working-age people, compared to four in

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Figure 1: Logo of the NESTORE project. According to Homer's Iliad, Nestor is the oldest and wisest of the Greek army chiefs against Troy, and is inclined to recall the historic achievements in his life, which lasted for three "human ages". Objective of this project is therefore to develop a companion – NESTORE - that, as the mythological Nestor, can give advice to older people so that they can maintain their wellbeing and their independence at home, based on experience and on understanding the current situation.

2013. For this reason, the EU is granting over 2 billion Euros of funding for research projects addressing the demographic change, with a particular focus on ICT solutions. In particular, the call SC1-PM-15-2017 [2] has been launched to support the development of a virtual coach for well-being and care of people as they age. There is a long history of research projects for assistive technology in older age but few of them managed to have a concrete impact on the society. Moreover, the urgency of finding a technological solution to an economic and societal problem makes researchers forget who should benefit from the research, i.e., the target users. Indeed, many assistive technologies do not match users' expectations and fail to become desirable products and services that will be adopted by the society [7].

The NESTORE project, funded under the SC1-PM15 call, aims at developing a virtual coach that promotes healthy lifestyles and helps maintaining a high functional capacity in older healthy individuals. The core challenge for the NESTORE consortium is empowering the users starting with the system design process and not only involving them as final testers. Understanding their real needs, habits and preferences is crucial for shaping the system functions and interfaces, to make them useful and usable. At the same time, the project itself might become an opportunity for many possible users to be part of the research process, shaping their own future through active participation in the project. The project will involve older adults from 4 different countries (UK, Italy, The Netherlands and Spain) for the co-design and test of the NESTORE system. In this paper, we present first an overview of the NESTORE project and the proposed interfaces for the NESTORE system. In

particular, we delve then into the co-design process, which aims at making this project different from many previous attempts in developing assistive technologies for older age.

### **The NESTORE project**

The NESTORE project aims at designing and developing a virtual coach that guides the user towards better everyday practices and activities, for maintaining and possibly increasing their functional capacity in four domains of well-being: physical activity, nutrition, mental well-being, social life. As the call advocates for an ICT solution, the NESTORE system will include a distributed environmental and wearable monitoring system, a cloud-reasoning engine and decision support system for the virtual coach intelligence, and the user interface of the coach. The NESTORE system will include also serious games and a social platform for promoting exchange of knowledge and competences and for promoting social contact among users and with their relatives.

In our vision, although the EU call advocates for a virtual, digital coach, the NESTORE coach should be seen as a friend, with whom the user can interact not only through digital communication means but also through natural physical interaction. In order to increase the trust in the system and the willingness to use it, we strive to build an empathic relationship with the coach through affective computing [6].

In the next section, we detail the proposed architecture of the coach interface showing how the users will be able to choose among different communication channels for interacting with the coach, according to their preferences or the context of the interaction.

### **Shaping the Coach Interface**

Two main challenges arise for the design of the NESTORE system: addressing the needs of older adults in the coach interface and in the definition of the training activities. For the coach interface, we plan to give access to the virtual coach intervention through multiple interaction channels. As smartphones become widely used at all ages, the mobile app solution is the standard approach for providing education content, detailed coaching information and an overview of progress in the intervention. Nevertheless, interaction in mobile apps is often impersonal and lacks the natural communication channels a user would expect from a human coach. To this purpose, we strive to integrate in the system a conversational agent, i.e., a chatbot, which should be able to interact with the user through text, voice and media content. Nowadays, chatbot platforms (such as Google DialogFlow, Microsoft Azure bot and LUIS) are able to provide Natural Language Processing for conversational agents, increasing the user experience of the interaction with a machine. Such conversations can be extended to vocal interaction using specific services for speech-to-text and text-to-speech conversion.

With the purpose of increasing the user's trust in the system, we would like to embody the virtual coach into a tangible interface, physically present in the user environment. In this manner, the virtual coach can become a home companion with whom the user can establish richer interactions. Besides the aforementioned voice interaction with the tangible companion, the user could enjoy other emotionally rich interactions, such as users' physical gestures (e.g., caressing, squeezing), physical movements of the tangible companion (e.g., head nodding, body shape

changes), and facial expressions (both expressions displayed by the companion and user's facial expression recognized through an embedded camera). All these opportunities might enrich the empathy of and for the virtual coach, eventually increasing the trust in the coaching intervention.

At the same time, the accessibility of the intervention through usable and natural interfaces must be accompanied by training activities that match users' interests and needs. Indeed, such training activities, as well the interaction with the coach, need to be seamlessly integrated into daily routines. Therefore, training activities in the four different NESTORE domains need not only to be validated by scientists (i.e., physiologists, nutritionists, and psychologists), but they should be also adapted to the local context of the users and to their preferences.

While the proposed interface might support an engaging coaching intervention compared to standard mobile eHealth interventions, the NESTORE system would be yet another unused assistive technology without the active involvement of the final users and of expert users into the design of the coach interface and of the training activities. Therefore, a key aspect for the success of the NESTORE project is involving the users into the shaping of the conversations that the chatbot can offer, of the function of the mobile interface, of the shape of the tangible embodiment of the companion and, most importantly, into the definition of the training activities. The co-design activities carried out to this purpose are described in the following sections.



Figure 2: Co-design workshop using the exhibition in a box methodology.

### Co-Design approach

The methodological approach followed in NESTORE provides for users to be involved in the design of the solution throughout the project duration. Literature highlights that the reason for non-acceptance of health technologies is complex. The role of the *co-design activities* is to better understand the broader physical and social environments in which services and technologies will operate and how they relate to the contexts of the end users' lives.

### *Exhibition in a box*

The methodology used for collecting user needs drew on an existing body of work developed by the authors [3,4,5], which uses objects and artefacts as methods to stimulate and scaffold thinking, offering valuable vehicles through which the complexities of lives can be understood. The concept of exhibition is embedded within the culture of art and design and has a long history as a form of gathering employed to prompt academic discourse.

Exhibition in a box [3] (Figure 2) takes the form of nine *objects defined through user workshops* across multiple research projects. The objects have been carefully selected to code, represent and prompt further discussion on themes that have *emerged through earlier research*. The objects form the basis of an exhibition, contained in a box a la Duchamp that can be transported to diverse environs including the home. Just as exhibition pieces invite individuals to express ideas and opinions and to articulate deeply held values and opinions so the objects provide an opportunity for participants to express their emotional responses, to respond to and describe things of importance in the context of the research theme.

Whilst traditional qualitative research methods using structured and semi-structured interviews can preference the views of the researcher who can make assumptions about what the issues are, Exhibition in a box offers participants the space to reflect, discuss, explore and define the real questions. The objects offer scaffolds for communication because at one and the same time they are both concrete and abstract.

### *Study Description*

Ethical approval for the study was granted from Sheffield Hallam University Ethics Committee October 2017. Between October 2017-January 2018 82 older user representatives were recruited from across organisations in Sheffield (Sheff Care, De La Salle Club, Lifestyle Matters group, Ministry of Craft) to participate in a series of NESTORE co-design workshops. Given the intended demographic of this phase of the study, University organisations and council departments within Sheffield were also targeted as a source of recruitment.

To date, a convenience sample of 62 individuals have engaged in these workshops with the remainder of the workshops planned to take place before the end of January 2018. The original intention was to facilitate 8 workshops with 10 people in each workshop but transcription of workshops containing such large numbers was prohibitive. Smaller workshops have therefore been facilitated alongside larger workshops to ensure accurate data capture.

Inclusion criteria for the study were:

- Community living older people aged 50 and over.
- Individuals able to give informed consent.

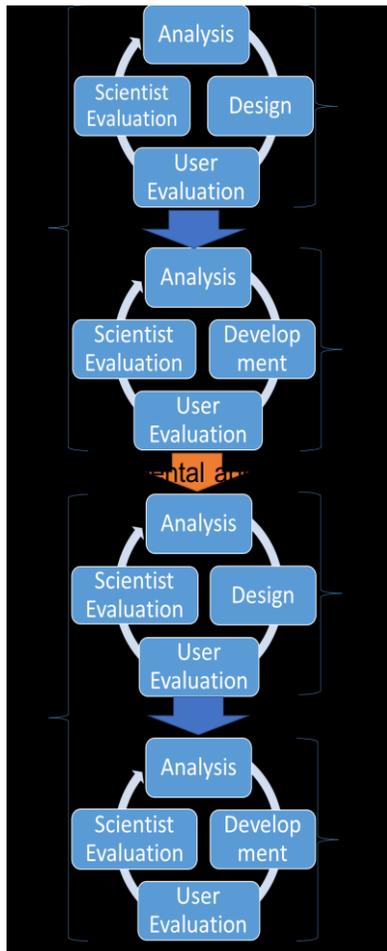


Figure 3: Schema of the system design process.

- People who had some degree of familiarity with the use of technology (reflecting future groups of people who may use NESTORE).

Workshops were facilitated across a number of different venues including community centres, people’s homes, and the user-laboratory space within Lab4Living at Sheffield Hallam University.

Each workshop lasted on average between one to two hours. The workshops began with a general introduction from the research team and an invitation for participants to share (verbally) activities they engaged in and found meaningful, with a particular focus on hobbies or leisure. Exhibition in a box was then introduced and participants were invited, in turn, to select and use the object to explore their ideas further (this might relate to the objects form, its sensory quality or a more metaphorical use). This was shared with the broader group. Participants were then invited to share associations that came to mind when they heard the word technology. Again, the critical artefacts were used to explore and interrogate these themes further.

Workshops will be replicated in three pilot sites, where the NESTORE system will be tested (Italy, Spain and The Netherlands).

### Interdisciplinary Co-Design Loops

The analysis of workshop results will be used to inform the design of the system. In particular, the system will be developed with an iterative incremental approach, which is illustrated in Figure 3. The coaching system will be first implemented for a single dimension of well-being (e.g., physical activity), using the insights

collected from the workshops as input for the selection of training activities. The design loops will start from the design of mockups that will be evaluated by users and physiologists to collect preliminary feedback. Those further insights will be then implemented in the first prototype that will be tested by users and validated again by the scientists. The process will continue with an incremental approach for the other coaching dimensions (social, nutrition and mental well-being).

In these iterative phases, it will be fundamental the input of target users. For this purpose, expert user groups willing to be actively involved in the co-design and evaluation process will be formed in each of the four sites.

### Results, Perspectives and Conclusion

Preliminary results from workshops in UK highlighted the duality in the perception of technology for healthcare, acknowledging its potential benefits but also evidencing a still persistent anxiety or frustration in the adoption of new technologies.

In the next months, workshops will be conducted in the other three countries to investigate whether results obtained in UK are influenced by cultural contexts. Deeper analysis of workshop results concerning user’s habits and perception of well-being will also lead to initial requirements for the design of the system mockups.

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