

NESTORE: An Embodied Tangible Conversational Agent for Older Adults

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Abstract

Older adults are increasing in Europe[1]. Technology may play a role in older adults' health. Giving technology the ability to be physically manipulated can result in creating trust[2]. According to Spreicer [3], co-designing tangible user interface with elderly people can increase the chance of technology acceptance. NESTORE [4] is a virtual coach that comes in different forms of modalities/interfaces: a chatbot, a mobile application and a tangible coach. This article focuses on presenting one of the interfaces of NESTORE: the "tangible coach". The tangible coach is an embodied conversational agent that seeks to empower older adults in becoming the co-producers of their wellbeing lifestyle through its tangible and its vocal interaction.

Keywords

Conversational Agent, Vocal Assistant, Ubiquitous Coach, Tangible Interaction, Multimodality, Wellbeing, Older adults

1. Introduction

1.1. Context

The well-being of older people will increasingly depend on technology [5]. Nowadays, society adopts technology for many reasons: people today are more connected with their friends, family and stores, and are more informed about all kind of information such as health awareness[5]. In fact, technology can also play an important role in the health of older adults. In particular, However, some research studies demonstrated the benefits of tangible user interfaces for older adults, thanks to their intuitiveness and fast learning curve [3]. We conducted a systematic review of existing virtual coaches designed for the well-being of older people [6]. We have focused on behavior change studies, coaching interventions, and technology architectures and designs. Our analysis revealed that e-coaching systems improving the well-being of the elderly are becoming an important topic in the field of IT. However, conversational agents in particular should not only make an e-coaching intervention as a convenient and user-friendly e-coach, but also help build empathy and increase user confidence and trust in the system. Thus, we concluded that the NESTORE virtual coach has three roles: a coach, a friend and a companion [7]. NESTORE is a virtual coach built with a vision to improve and maintain the health of

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the elderly in different areas of well-being such as: physical, nutritional, social, cognitive and emotional. NESTORE follows a behavior change model called HAPA which aims to help the user move from a motivational phase of using the system to a voluntary phase to become a co-producer of the system. This model is also followed by the BCT techniques which aim to create long term sustainability of the use of the e-coach. NESTORE comes in different interfaces such as a mobile application, a chatbot which is a text messaging application and a tangible coach which is a voice assistant.

NESTORE^[4] tangible coach is a conversational agent embodied in a physical device. It has 2 main abilities: vocal ability and tangible ability. The coach's tangible vocal ability is designed to have a natural conversation with the user, whereas, the tangible ability and the physical design of the tangible coach are co-designed with users from different countries (UK, Spain, Netherlands and Italy). In each country, we discussed their smart speaker needs and requirements with users. Then we gave users different designs and features with multiple iterations until we finished our design with our now tangible coach. The objective of the NESTORE tangible coach is to improve and maintain the well-being of the elderly by playing the three roles mentioned above through its two main modalities of interaction: (1) tangible interaction and (2) voice interaction. The aim of this article is to show the design of the NESTORE tangible voice coach while focusing on their tangible abilities and vocal abilities and how the combination of a voice assistant with tangible abilities plays a key role in being a coach, a friend and companion of the user.

1.2. Research Questions

The NESTORE tangible coach consists of building trust in order to become a friend, empathy with older adults in order to become a companion while e coaching them for a healthier lifestyle^[7]. the journey. In order to that we need to answer some problematic:

- How can the physical design and direct manipulation through “touching” the e-coach builds a form of bonding and companionship with older adults?
- How can the tangible coach vocal capability and tangible capability motivate older adults to become his or her friend and build trust?
- How can tangible interaction with vocal capability improve or maintain the wellbeing of older adults?

2. Design of the tangible coach

2.1. The tangible modality

The tangible coach has an oval shape, is white, and made of 3D printed plastics with a textile cover for a cozy and emotional feel to the touch, supposed to encourage tangible manipulation. The aim was to create a feeling of companionship (Q1). The tangible coach has its main face which is when the device is positioned on its side. This oval face is the main part of

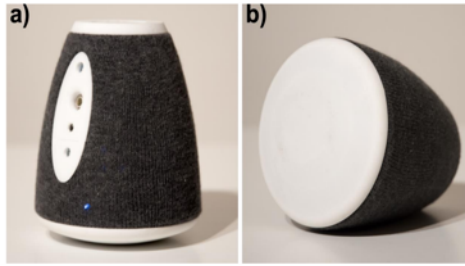


Figure 1: Tangible Coach in Sleep State (a) and Awake State (b).

this body which looks like a human face. Users can communicate with it through its different light models. His human face expresses a specific act. Such acts are "the tangible coach who listens" or "the tangible thought of the coach" or "the tangible coach who speaks". These acts are represented by LED patterns. This type of interaction is what we will call expressive interaction, which means that the tangible coach will convey his data by expressing it with his interface(Q1). The tangible coach has two main states: the state of sleep and the state of wakefulness. To switch between these two states, the user consists of touching the tangible coach, and changing the position of the tangible coach. In fact, the sleep state is when the user puts the small base up and the large base on the table, as shown in Figure 1a). In the sleep state, the tangible coach does not interact with the user and cannot listen, think, or speak. During our co-design process with the user, we concluded that older people care a lot about data privacy and prefer the tangible coach not to listen to them all the time or talk to them without permission(Q2). In the awake state, that is to say when the device is positioned on its side as illustrated in Figure 1 b). As it seems, the tangible coach is awake, waiting for the user to call (the wake-up word) and start speaking. The awake state consists of three substates (or acts): the listening substate, the thinking sub-state, and the speaking sub-state, as illustrated in the diagram in Figure 3. Each sub-state is designed with LED patterns and colors to show the user what sub-state the device is in. In other words, when the tangible coach is listening (sub-listening state), the tangible coach shows an orange circle on its front base for 10 seconds. Then the trainer will start showing an orange and white colored LED pattern rotating around the front base circle indicating that he is thinking about an adequate answer depending on the question. Finally, once the tangible coach has their response ready, the LEDs will begin to flash orange in a circle shape while speaking the response. Figure 2 shows the LED model of the tangible coach during the listening sub-state (a) and the thinking sub-state (b).

2.2. The vocal modality

The tangible coach is based on Google Cloud speech to text and text to speech [8]. It focuses on a natural conversation with users. The whole logic and scenario of the conversation are processed with RASA, a natural language processing framework that detects the intentions and intentions of a text. This will lead to imitating a human to human conversation. Plus, the turn of the conversation is two-sided. The user or the tangible coach can initiate the conversation. Voice interaction is used with the support of visual information displayed via LEDs. The LEDs

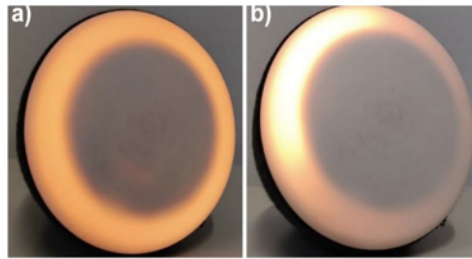


Figure 2: Tangible Coach in Listening Substate (a) and Thinking Substate (b)

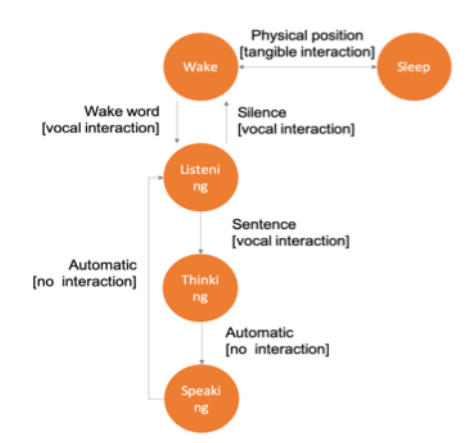


Figure 3: Full Diagram of the tangible coach interaction

generate sufficient light that can provide the information anyway even if the user is not looking directly at the device, harnessing peripheral attention, allowing multitasking to be supported. Finally, the user can still talk to the device even if it is not in the line of sight and continue to interact with it while performing other activities. This kind of behavior aims to show the user that the system can be talked to and thus build a feeling of trust(Q2) which is found usually among friends. The conversational agent can cite the user’s planned and recommended activities, the user’s score with comments, notifications, and congratulatory messages (Q3).

3. Evaluation

In order to answer our research questions, the tangible coach is tested on a three-month basis. For each problematic, we will evaluate the tangible coach through questionnaires or logging through our system. Q.1 How can the physical design and direct manipulation through “touching” the e-coach builds a form of bonding and companionship with older adults? To answer Q.1, we will evaluate the use of this embodied tangible coach with the Companion Animal Bonding Scale questionnaire [9] to assess the level of companionship the tangible coach has given to the user. Q.2 How can the tangible coach vocal capability and tangible capability moti-

vate older adults to become his or her friend and build trust? To answer Q.2, we will assess the friendship between the coach and the user by using the friendship scale questionnaire [10] and by logging from the interface and the backend [4] when and how much the user has interacted with the tangible coach. Hence, one can understand the probability of a long-term use. Q.3 How can tangible interaction with vocal capability improve or maintain the wellbeing of older adults? To answer Q.3, we will evaluate the relationship between the user-e-coach through a coach-athlete CART-Q questionnaire [11].

4. Conclusion

NESTORE tangible coach aims to use its tangible capability and vocal capability to create empathy, trust and coaching older adults to have a healthy lifestyle. The system will be tested in three European countries (Spain, Italy and the Netherlands). The questionnaires will show whether the sense of companionship, friendship and coaching are fulfilled.

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References

- [1] D. A. Chlon, I. Kotowska, J. Kurkiewicz, A.-K. A, S. M, Population ageing in europe: facts, implications and policies. brussels: European commission, 2014.
- [2] L. Angelini, E. Mugellini, O. Abou Khaled, N. Couture, Internet of tangible things (iott): Challenges and opportunities for tangible interaction with iot 5 (2018) 7.
- [3] W. Spreicer, Tangible interfaces as a chance for higher technology acceptance by the elderly, in: Proceedings of the 12th international conference on computer systems and technologies, 2011, pp. 311–316.
- [4] M. El Kamali, L. Angelini, M. Caon, G. Andreoni, O. A. Khaled, E. Mugellini, Towards the nestore e-coach: a tangible and embodied conversational agent for older adults, in: Proceedings of the 2018 ACM International Joint Conference and 2018 International Symposium on Pervasive and Ubiquitous Computing and Wearable Computers, 2018, pp. 1656–1663.
- [5] D.-D. Deborah, O. Lindeman-Marcia, 70 % of seniors are now online and using technology, <https://www.weforum.org/agenda/2019/07/no-longer-just-for-the-young-70-of-seniors-are-now-online/>, 2019.
- [6] M. El Kamali, L. Angelini, M. Caon, F. Carrino, C. Röcke, S. Guye, G. Rizzo, A. Mastropietro, M. Sykora, S. Elayan, et al., Virtual coaches for older adults' wellbeing: A systematic review, *IEEE Access* (2020).

- [7] M. El Kamali, L. Angelini, M. Caon, D. Lalanne, O. Abou Khaled, E. Mugellini, An embodied and ubiquitous e-coach for accompanying older adults towards a better lifestyle (2020) 23–35.
- [8] Google cloud speech to text and text to speech, <https://cloud.google.com>, 2020.
- [9] R. H. Poresky, C. Hendrix, J. E. Mosier, M. L. Samuelson, The companion animal bonding scale: Internal reliability and construct validity, *Psychological Reports* 60 (1987) 743–746.
- [10] G. Hawthorne, Measuring social isolation in older adults: development and initial validation of the friendship scale, *Social indicators research* 77 (2006) 521–548.
- [11] S. Jowett, N. Ntoumanis, The coach–athlete relationship questionnaire (cart-q): Development and initial validation, *Scandinavian journal of medicine & science in sports* 14 (2004) 245–257.