



NESTORE

D5.3 Tangible Interfaces

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Abstract

This report shows how the NESTORE tangible coach works, describing the different coach states and the actions that allow to change from one state to the other.

The tangible coach allows the user to interact with the NESTORE Virtual Coach in oral form. The intelligence of the NESTORE Virtual Coach is the same and is based on the Decision Support System and the Emotion Engine. The user can interact with the tangible coach changing its state via physical manipulation. When the tangible coach is in wake state, both the user and the NESTORE coach can start the conversation. In fact, the coach will address the user when a new notification is available. However, the user will have to say the wakeword in order to let the coach understand that the user is addressing the coach and to start the conversation. When the tangible coach is in sleep state, the coach will not be on listen and will not hear the user. When the coach is in the awake state and the user did not say the wakeword “NESTORE” then the coach will not know that the user is addressing him. The tangible coach can handle oral conversations in four different languages: English, Italian, Dutch and Spanish. Conversations are used both for coaching and for collecting data from the user. This document presents an overview of the tangible coach and shows the forms of interaction the user can have with it. The theoretical background, the design process and the implementation details of Task T5.3 have been partially presented in D5.3.1 and will be detailed in an extended version of this document (not publicly available).

Key Words

Vocal interaction, tangible, coach



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1 Introduction

The tangible coach has been designed as part of the larger NESTORE ecosystem. Its main purpose is to enable the user to interact in his/her apartment with the NESTORE coach without having to always focus on his/her smartphone. The interaction with the tangible coach has been designed to leverage the natural forms of human interaction such as physical gestures and vocal commands.

1.1 Interlinks with other Work Packages

D5.3 is the demonstrator of T5.3, task of WP5 devoted to the design and development of the tangible coach. The tangible coach allows interacting through tangible gestures and vocal interaction with the NESTORE Virtual Coach. WP5 role is to present to the user the coaching recommendations and plans elaborated in the Decision Support System (developed in WP4). Recommendations are based on data collected in WP3. Coaching assumes different forms, which are based on the behaviour change techniques individuated in T5.1 and orchestrated according to the HAPA model. In T5.3, coaching is presented to the user in form of oral conversation and the user can change the tangible coach state manipulating the position of the physical object. If the tangible coach is in wake state, both the user and the NESTORE Virtual Coach can start the conversation. If the tangible coach is in sleep state, the user will not be able to communicate with the coach because the coach is “sleeping”. To wake the coach up, the user should turn it to the wake state and call it by its wakeword. In the NESTORE ecosystem, it is possible to interact with the same artificial intelligence animating the NESTORE Virtual Coach through a chatbot interface developed in T5.6 and further details can be found in D5.6. The algorithms for the elaboration of user’s data and for the recommendation system are developed in T4.3 and their description can be read in D4.3. T5.2 is dedicated to the design and development of the conversational and emotional interaction with the NESTORE Virtual Coach, which implies the algorithms for text mining and sentiment analysis aimed at enabling the recognition of specific emotions. The ability to recognize the user’s emotions is intended for tracking his/her mental wellbeing and establishing an affective interaction between the user and the NESTORE Virtual Coach. The description of this demonstrator is reported in D5.3. The form, the functions and the proposed conversations in the tangible coach have been co-designed with users in WP7 (T7.2 and T7.3). Conversations in English, Italian, Dutch and Spanish have also been translated and adapted with the help of pilot sites’ staff. Finally, it is worth noting that the conversational agent is used not only for coaching but also for monitoring different aspects of the user’s wellbeing, complementing WP3 sensors. Data collected through the chatbot (questionnaires, preferences, and food-intake) and the tangible coach (emotionally-rich sentences) are sent to the NESTORE platform and analysed by WP4 modules.



2 Demonstrator

The tangible coach is a smart physical object that enables older adults to have tangible and vocal interaction with multiple services. This tangible device is designed to be placed anywhere in a user's house and only requires an Internet connection to activate the vocal interaction to access its services. Its name is NESTORE and it is another representation of the virtual coach in the European project NESTORE. It has an oval form, it is white and made of 3D printed plastics with a cover in textile for a cosy and emotional feeling to the touch, supposed to encourage physical manipulation. It is possible to interact with this device in two modalities: tangible and vocal interaction. Physically manipulating the position of this device, it is possible to change the coach state. The conversation with the tangible coach aims at informing the user on activities of the day, which are designed to improve the senior's wellbeing in multiple domains. Furthermore, the tangible coach informs the user about his/her progress in these aforementioned domains and, last but not least, provides a sense of companionship entertaining the user with casual conversations. In the remainder of this section, a summary of the coach modalities, functionalities and actions will be explained.



Figure 1. The NESTORE tangible coach

2.1 Description of the demonstrator

2.1.1 Interaction modalities

The tangible coach has been designed to implement two main interaction modalities: the tangible interaction and the vocal interaction. The tangible user interfaces denote systems that rely on “embodied interaction, tangible manipulation, physical representation of data, and embeddedness in real space” (Hornecker and Buur, 2006). Vocal interaction refers to the ability of the tangible coach to have a conversation with the user, interacting through the spoken word like he/she would do with another human being; such systems are known under the name of embodied conversational agents (Cassell et al., 2000). Both interaction modalities are inspired by the natural way of humans to interact with other people and the surrounding environment. Indeed, the current trend in human-computer interaction is to implement interfaces that can leverage the natural forms of communication and manipulation based on human skills.

These two different modalities were designed also to implement the principle of proxemics, which is the study of human use of space that can characterize a behavior or social interaction. In this case, the user, in order to physically manipulate the tangible coach, has to be close to the device and touch it; while the vocal interaction can happen in any part of the room, without requiring proximity but only the possibility to hear the audio.



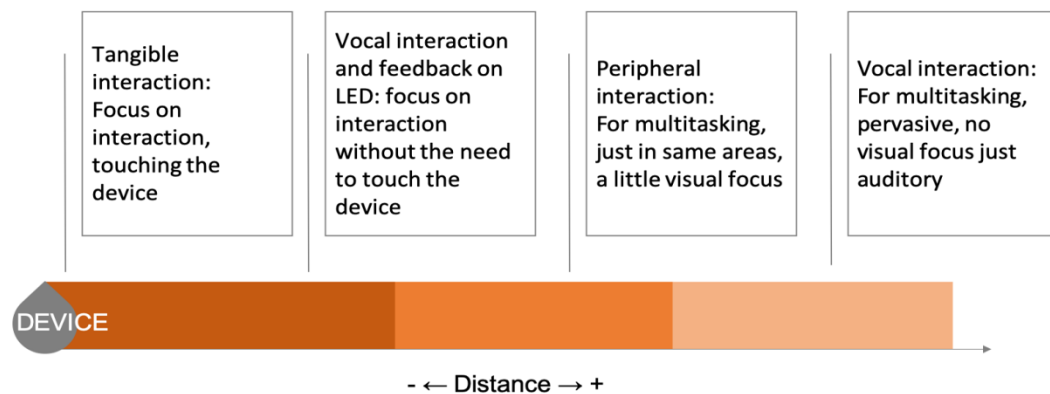


Figure 2 - Relationship between interaction modality and proxemics

The proxemics influences the modality of interaction between the user and the device as shown in Figure 2. If the user requires to do an important task, then he/she has to touch the device and manipulate it physically (i.e., changing the tangible coach state). Other tasks can require the user's focus of attention without the need of physical contact. In this case, the vocal interaction is used but with the support of visual information displayed via LEDs. LEDs generate a sufficient light that can anyway provide some information even if the user is not directly looking at the device, exploiting the peripheral attention, which allows for supporting multitasking. Finally, the user can still talk to the device although it is not in line of sight and keep interacting with it while performing other activities.

2.1.2 Actions and functionalities

Via the tangible interaction, it is possible to change the coach's position. There are two positions: the coach is in a "sleep" state if the device has the small base up and big base on the table, as depicted in Figure 3 a). In the sleep state, the tangible coach does not interact with the user. In the "wake" state, which is when the device is positioned on its side, the coach can hear when the user call its name and when the user starts talking to the coach, as shown in Figure 3 b).

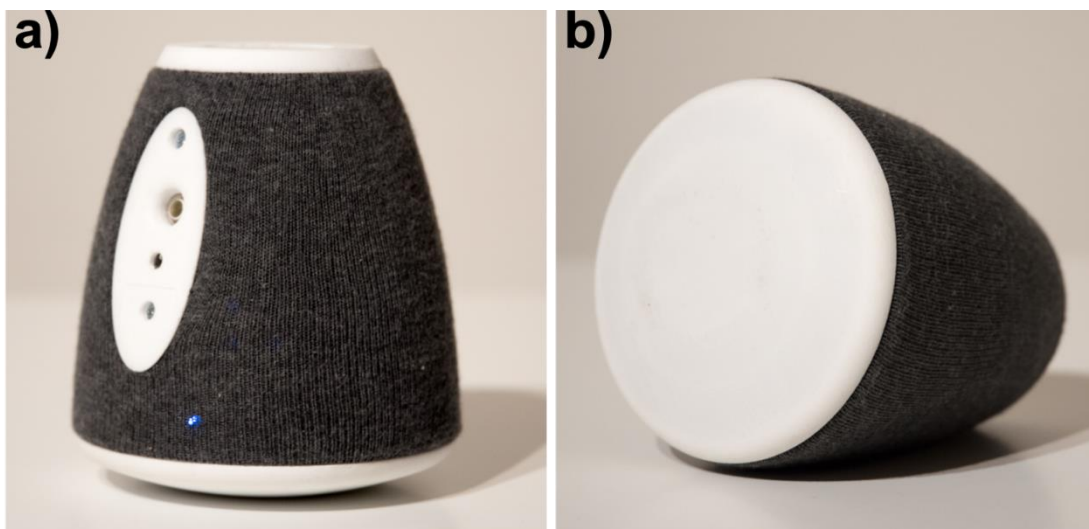


Figure 3: The tangible coach in its two positions: a) vertical for sleep state and b) horizontal for wake state.

When the tangible coach is in the wake state, it is possible to start a dialogue with it. Via the vocal interaction, the user can interact with the tangible coach by calling him by its name "NESTORE". Once, the coach detects its name, the user can start talking with the coach.

The 3 states of the coach for vocal interaction are:

1. Listening state
2. Thinking state
3. Speaking state

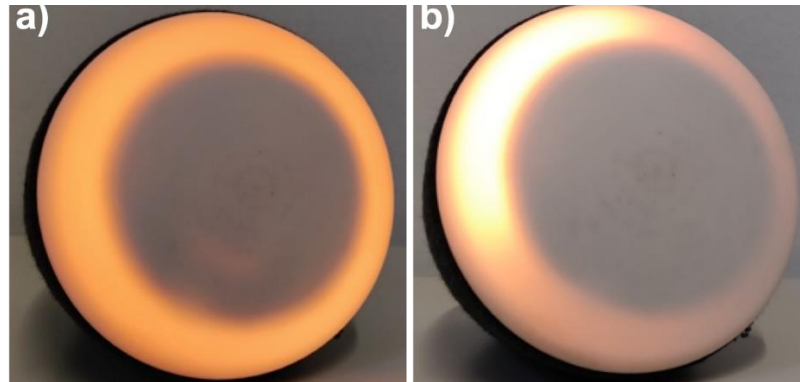


Figure 4: The LED patterns of the tangible coach in a) Listening state and b) thinking state.

When the coach is listening, the color of the front base of the tangible device is orange, as represented in 4 a). The coach can listen to the user for 10 seconds. If the user says nothing, the coach will end the listening state and goes to the wake state. In case the user talks to the device while the coach is listening, the coach will detect her sentence and think about an answer while showing the user a different lightning system, as shown in 4 b). In fact, The colors orange and white are turning around in clockwise. Finally, when the coach wants to answer the user, the front base of his body will blink between orange and white. All the states and the changes between these are reported in Figure 5.

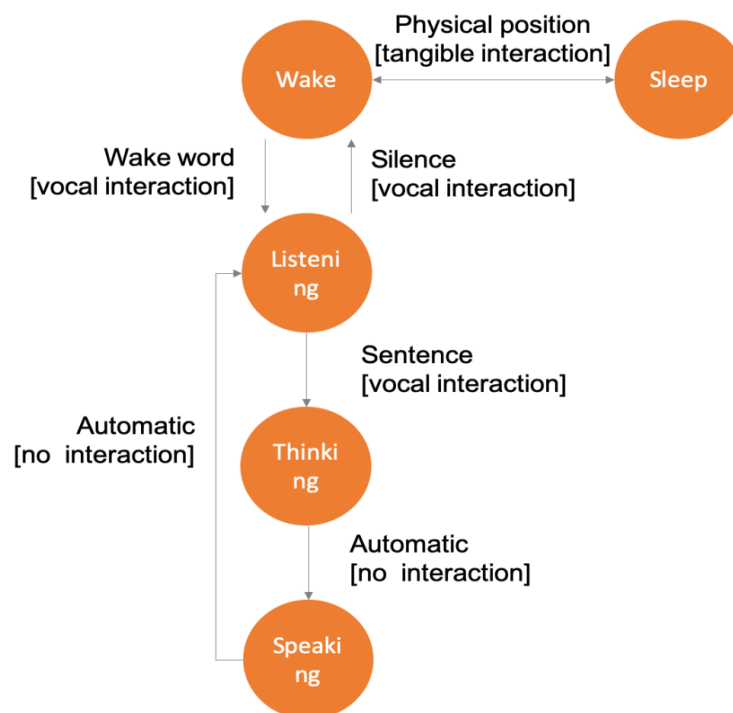


Figure 5: Diagram depicting all the tangible coach's states and how it can pass from one to the other.

During the dialogue, after the wake word “NESTORE” has been recognized by the device, the type of questions that the coach will definitely answer the user are:

- The coach will cite all the activities the user should do today depending on his/her requests.
- The user can ask the coach on a specific domain.
- The user can ask the coach on all activities of any domain
- The user can ask the coach to review his/her score on any domain. The user can ask the coach this coach in 2 different ways:
 1. The user can ask the coach to review his/her score in general. The coach will have a small conversation with the user in order to understand which domain the user would like to start with.
 2. The user can ask the coach to review his/her score in a specific domain. In other words, the user can mention the domain(between physical, nutritional, cognitive, social or emotional domains) he/she would like to review his/her score.
- The user should be able to ask the coach any question for learning about how to use the tangible coach.
- The coach will ask the user about how she feels to record her emotional status. Moreover, the coach can recognize the user's emotional status and update the chart in the social platform only when the user confirms that the recognized emotion is correct.

The coach speaks four languages: English, Italian, Spanish and Dutch

2.1.3 Tangible Coach Setup

The user has to download the NESTORE Connect (formerly named WoT agent) in her Android smartphone in order to configure the coach via Bluetooth. This mobile app can be downloaded directly from the Google Play store [1].

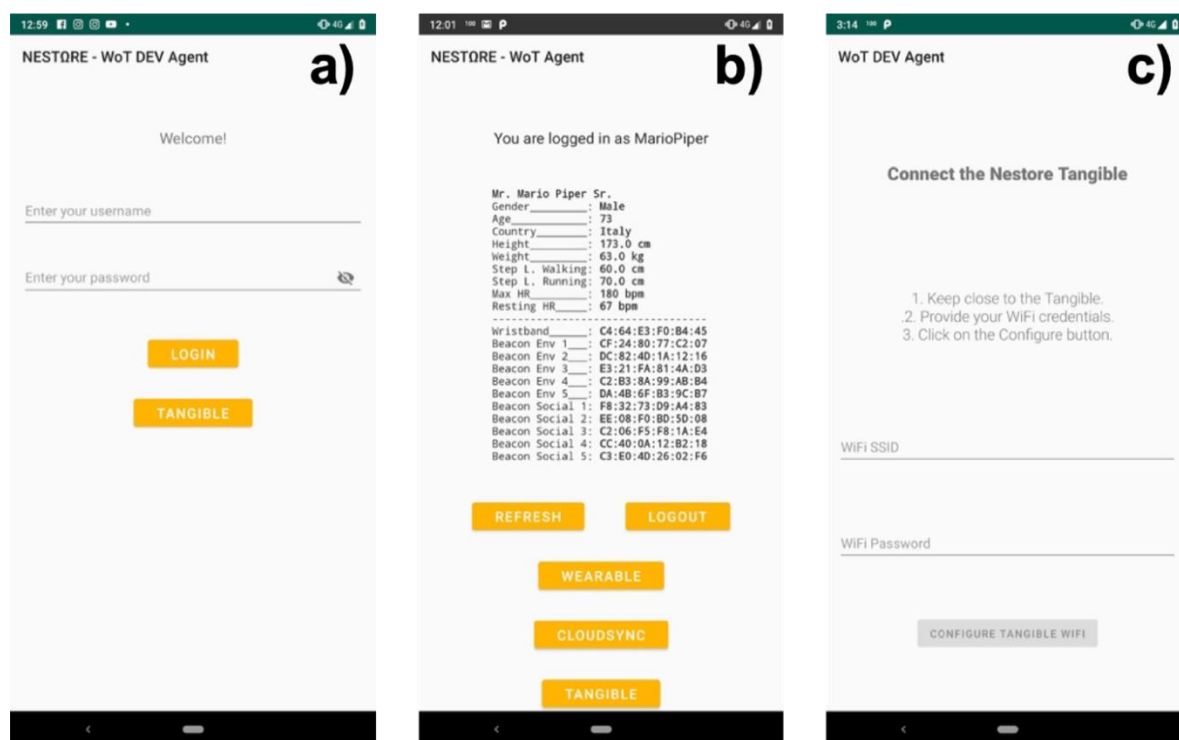


Figure 6: Screenshots of the NESTORE Connect app

Once the user has downloaded the NESTORE Connect app, he/she can login using his/her NESTORE credentials as shown in Figure 6 a) and, then, clicking on the tangible button in yellow as shown in Figure 6 b), the user will be able to choose or detect automatically the NESTORE tangible coach in order to send her WiFi credentials. This task might take a bit of time since the NESTORE Connect is sending the NESTORE account credentials and the WiFi credentials. In fact, the NESTORE credentials (token and language parameter) are sent in the background when sending the WiFi credentials.

In order to enable the configuration of the WiFi, of the token for accessing the NESTORE cloud and of the language parameter, the tangible coach will behave as following:



At the beginning, the tangible coach will check if there is a connection to the Internet. In case there is no Internet connection available, 2 blue LEDs and 2 red LEDs will be shown which means that the coach has made itself discoverable for other bluetooth devices. Then, the tangible coach will wait for the user to configure the username, password via Bluetooth (Figure 6 c). Once the NESTORE Connect finds the nestore-tangible device, the user can send the WiFi credentials. After putting the WiFi credentials, the user should press the button "configure tangible WiFi". If the NESTORE Connect app connects to the tangible coach, then the tangible coach will make a typical sound of connection successful. If not, the NESTORE Connect will show the error of this process. After waiting some time for data transfer, the tangible coach will show to the user a blue steady color and it will be ready for being used as described in section 2.1.3. If the process failed then the coach will re-show the 2 blue LEDs and the 2 red LEDs waiting for the user to resend the WiFi credentials again.

2.1.4 Charging level of the tangible coach

The coach should be charged on a daily basis in order to keep it always ready to be used. The coach can be charged with a magnetic cable that will be included in the bundle, as shown in Figure 7. The user can charge the tangible coach when he is in the sleep, the awake state and also while talking to the user. The user will be able to see via the LEDs of the coach whether it is charging and its charging level. The user can check the charging level and the charging state every time he/she moves the coach from the sleep state to the wake state. Before the user starts talking to the coach, the LEDs will show at the beginning the charging level. Once the user is talking to the coach, the user will not be able to see the charging level but only interact normally with the coach. If the user wants to see again the charging level, the user must put the coach on sleep state and then return it to the wake state. In other words, to see the charging level, the user should put the coach like in Figure 3 a) and then put it back like in Figure 3 b)



Figure 7: The tangible coach is being connected to the cable to start charging its battery.

The charging level comes in 3 different colors. If the battery is 50% charged and more then the tangible coach will show green LEDs color (Figure 8). If the battery is between 30% and 50% then the tangible coach will show yellow LEDs color (Figure 9). If the battery is less than 20% then the tangible coach will show red LEDs color (Figure 10). Note that the percentage of LEDs turned on when showing the charging level is equal to the percentage of the battery charged. The charging status is also shown through the LED ring: if the tangible coach is charging (i.e., the magnetic cable is attached to the coach), the last LEDs of the charging level will be blinking; otherwise, the charging level is static.



Figure 8: Charging Level 70%



Figure 9: Charging Level 30%



Figure 10: Charging Level 10%

2.2 Implementation

The tangible coach has been built using a Raspberry PI 3 A+ and the Matrix Voice shield. An accelerometer is used to detect the orientation of the coach. The software has been implemented in Python and runs in the Raspberrian OS. The wakeword has been implemented using the Snowboy library. Speech recognition and Text-To-Speech are implemented using Google Speech services in anonymized form. With the current option, Google do not store any data sent from the tangible coach. Once user's speech is converted to text, the text is sent to the NESTORE Conversational agent (T5.2), which sends back an answer (text) to the tangible coach. Finally, the Text-To-Speech service is used to obtain the corresponding audio to be played in the tangible coach speaker.

The hardware used to build the tangible coach are:

- Pijuce HAT[1] : to make the coach running on battery
- Matrix voice [2] : to have to microphone and the LEDs
- Raspberry pi a+ model [3] : to make the whole brain of the coach
- Speaker [4]: to provide the coach the sound
- LIS3DH accelerometer [5] : to orient the position from sleep state to awake state

2.3 Link(s)

The demonstrator of T5.3 is the tangible coach, a physical device that has been designed and built by HES-SO in collaboration with SHU and POLIMI. The following video shows the main functions of the tangible coach. Further details about the conversations designed for the tangible coach can be found in D5.2.

Link to the video: <https://drive.switch.ch/index.php/s/LGbB0GgzhMir13z>

The tangible coach need to be configured via the WoT agent app (currently called NESTORE Connect)

[1] <https://play.google.com/store/apps/details?id=com.neosperience.nestoreagent>

3 References

Hornecker, E., & Buur, J. (2006, April). *Getting a grip on tangible interaction: a framework on physical space and social interaction*. In *Proceedings of the SIGCHI conference on Human Factors in computing systems* (pp. 437-446). ACM.

Cassell, J., Sullivan, J., Churchill, E., & Prevost, S. (Eds.). (2000). *Embodied conversational agents*. MIT press.

Hardware links:

[1] <https://uk.pi-supply.com/products/pijuice-standard>

[2] <https://nl.farnell.com/matrix-labs/matrix-voice/matrix-voice/dp/2846912>

[3] <https://www.kiwi-electronics.nl/raspberry-pi-3-model-a-plus?>

[4] <https://www.adafruit.com/product/3351>

[5] <https://www.sossolutions.nl/2809-adafruit-lis3dh-triple-axis-accelerometer-2g4g8g16g>

