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LAB DEMONSTRATOR OF PILOT KIT	
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Project Acronym:	HELICOPTER
Project full title:	HEalthy LIfe support through COmPrehensive Tracking of individual and Environmental Behaviors
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1. Introduction

The purpose of HELICOPTER project is develop an Ambient Assisted Living System to provide older adults with support, motivation and guidance in pursuing a healthy and safe lifestyle.

A key aspect of the project is represented by pilot trials that will provide the validation of the system usability and will allow the assessment of benefits brought to and perceived by the end users.

A preliminary prototype of the typical “pilot kit” has been devised in order to tune the adopted approach, test the integration of sensors, communication infrastructure and user interface, and debug the technical issues.

In this document, the Lab Demonstrator of the pilot kit, realized in a lab of University of Parma (UNIPR), is described.

The Demo Lab aims to illustrate how the different parts of the HELICOPTER system behave, perform and interact.

In particular, the Demo Lab illustrates basic components of the monitoring system, including environmental, personal and clinical sensors.

The Demo Lab consists in a reproduction of domestic environments. In particular, three different living areas are taken into account: a kitchen section, including some appliance and kitchen furniture, a living room section, including an armchair and a “health corner” equipped with clinical sensors, and a bathroom section, including safety and behavioural (water flow, toilet flush) sensors.

Data coming from sensors are gathered and stored in a DataBase hosted in a local server (a PC): the full communication infrastructure is implemented, including a ZigBee network for wireless sensor communication and a WiFi network for user interface management. The server PC also accounts for Bluetooth communication toward BT-enabled clinical sensors.

Of course, the lab is inherently unfit for acquiring meaningful behavioural data of for testing end-user’s impact. The kit demonstrator is therefore limited to infrastructure components and does not include behavioural modelling software and actual user interfaces. Both components are being designed indeed, based on the outcome of user studies and are being described and demonstrated elsewhere. A “service” user interface is provided, in order to allow for checking proper function of each component.

In the next section of this document, sensors installed in the demo lab and their operating mode are discussed.

Note:

In this document, we focus at the demonstrator description. A detailed, technical description of each component is beyond the scope of this document, and can be found in D3.1.

2. Demo Lab description

The HELICOPTER System is based on a technological infrastructure that includes:

- **wearable devices** that provide personal information about the user identification and activity;
- **environmental sensors** that provide data related to the user interaction with the home environment;
- **clinical sensors** that provide the system with personal data about physiological parameters.

All these technologies are demonstrated in the Demo Lab.

The lab is divided in two parts:

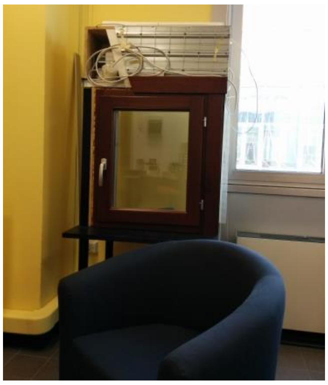
- the zone with the desks and the workstations of the university researchers (PhD students, research fellows and technicians) directly involved in HELICOPTER;

- the zone furnished to simulate a home environment.

The home-like environment includes:

- a door equipped with a "smart gate"
- a "kitchen corner" , with kitchen furniture and appliances
- a "living room" with an armchair
- an "health corner" with clinical sensors
- a bathroom, in a restroom close to the lab room.

a. the kitchen corner



b. the living room

c. Helicopter reserchers' desk

The smart gate

The entrance of the Demo Lab is a door equipped with a ZigBee environmental sensor, named CARDEAGate, capable of detecting the crossing of a person. Furthermore, if the user is wearing a MuSA device, CARDEAGate is able to identify him.

MuSA is a wearable ZigBee multi-sensor platform, specifically designed with assistive purposes that, among other functions, can communicate with other Zigbee devices, allowing for user identification.

The kitchen

The kitchen-corner zone is made of:

- furniture that hosts an oven and an induction stove
- a fridge
- a hood
- some other appliances, as a microwave oven and an electric kettle

Environmental sensors installed in this zone are:

- Drawer sensor – a ZigBee device that exploits a magnetic contact to detect the open of a drawer of the kitchen furniture. Furthermore, this sensor enables the user identification if he wears the MuSA device.
- Fridge sensor – a ZigBee device placed inside the fridge that detects door opening, temperature, humidity. Furthermore, this sensor enables the user identification if he wears the MuSA device.
- Cooking sensor – a ZigBee device placed close to the hob stove (for example, above the hood) to detect cooking activity.
- Power meter – a ZigBee smart plug that enables to measure the instant electrical consumption; in this case it is used to monitor the consumption of some appliances as the oven or the electric kettle.

The living room

- Presence sensor (PIR: Passive InfraRed) – a ZigBee, wall-mounted device that detects the motion of a person in the room.
- Chair occupancy sensors – a ZigBee device connected with a soft pad that detects the occupancy of a bed or a chair. It is installed on the armchair.
- The same sensor enables the user identification if he wears the MuSA device.
- The same technology, with differently shaped pads, is used for bed occupancy monitoring. Due to space limitation, bed sensor is not implemented in the lab.
- Other sensors are used to monitor opening of a (fake) window and similar applications.

The "health corner"

Several clinical sensors installed in the Demo Lab compose the "health corner".

The list of currently considered sensors includes:

- Body Weight Scale
- Blood Pressure Monitor
- Pulsoxymeter
- Glucometer
- Portable ECG

All of these clinical sensors have a Bluetooth communication channel that allows for the connection to a gateway (a PC) that can gathers the data, writing the results of measurements in the HELICOPTER DataBase.

In order to automatically associate clinical measurements to a given user (among those living in the same home), the "health corner" features a chair equipped with an occupancy sensor. When the user sits to start his clinical measurements the sensor detects his presence and identifies the user. The system then suitably couples identification and clinical data.

The bathroom

The bathroom sensors are implemented outside of the lab, in a near restroom. In this environment are installed:

- Flood sensor – a ZigBee device that enables to detect the presence of a flooding.
- Water flow sensor – a ZigBee device used for water flow metering. Furthermore, this sensor enables the user identification if he wears the MuSA device.
- Presence sensor (PIR: Passive InfraRed) – a ZigBee wall mounted device that detects the motion of a person in the bathroom.

3. An experimental scenario

The above components (or a subset of them, based on actual user's need) will be deployed at pilot user's home. The lab aims at testing the prototype of the "pilot kit" in a "multi-user" environment, limiting to the lower hierarchical layer, i.e., not including (for the time being) actual behavioral model processing and user's feedback. To this respect, the lab is not aimed at actual and-user training and demonstration: besides testing function, it is conceived, instead, for illustrating main system components and their basic work to partners supporting pilot implementation and dealing with user studies.

In the DEMO LAB, mimicking the user behavior, the system can be tested in situations close to the aimed ones. A simplified User Interface (UI) is available, showing in real time the status of each sensor.

The experimental scenario is described below:

Staged situation	**Information displayed on the UI**
A researcher plays the role of a user. He wears the MuSA sensor. User:	
- Enters the bathroom. PIR sensor detects his moving	- The bathroom PIR icon is turned on
- Opens the water faucet. The water flow sensor detects the event and identifies the user	- The water flow icon is turned on - The water flow rate is indicated - Identification of the user in the bathroom is shown
- Closes the water faucet	- The water flow icon is switched off
- Activate toilet flush	- Toilet flush icon is switched on
- Enters the DEMO LAB. The smart gate sensor detects the crossing and identifies the user	- The smart gate icon is turned on - User identification in the DEMO LAB environment is shown
- Opens the fridge and take some food	- The fridge door icon is turned on - User identification near the fridge is shown
- Closes the fridge door	- The fridge door icon is switched off
- Turns on the electric kettle. The smart plug sensor measures the power consumption	- The kettle icon is turned on - The power consumption is indicated
- Turns off the electric kettle.	- The kettle icon is switched off
- Opens the drawer. The drawer sensor detect the opening and identifies the user	- The drawer icon is turned on - User identification near the kitchen furniture is shown
- Closes the drawer.	- The drawer icon is switched off
- Sits at the "health corner" chair and start using the clinical sensors. The chair occupancy sensor detects and identifies the user. The clinical sensors communicate the results of the measurements at the system	- The chair occupancy icon is turned on - User identification is shown - The result of measure_1 is indicated - The result of measure_2 is indicated - The result of measure_3 is indicated