ROBOTS IN ASSISTED
LIVING ENVIRONMENTS

UNOBTRUSIVE, EFFICIENT, RELIABLE AND
MODULAR SOLUTIONS FOR INDEPENDENT AGEING

Research Innovation Action

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DELIVERABLE 5.4

User Interfaces

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Abstract

This report describes the RADIO Graphical User Interface for the end-users. It includes a detailed list of design and technical requirements, the mock-up, and the snapshots of the first GUI prototype.

History and Contributors

Ver	Date	Description	Contributors
01	23/03/2016	Pre-final draft.	NCSR-D, S&C, ROBOTNIK
02	29/03/2016	Internal peer review.	FZ
03	29/03/2016	Addresses peer review comments.	NCSR-D
Fin	29/03/2016	Final preparations and submission.	NCSR-D

Executive Summary

This document reports the design methods and software components used to create the first prototype of the unified smart home/robot *end-user interface*. In particular, it describes the target group and the GUI's design and technical requirements. Moreover, the software components needed for human (GUI) -robot interaction functionalities are also reported. Finally, the GUI mock-up and actual design are presented.

Abbreviations and Acronyms

GUI	Graphical User Interfaces
UI	User Interfaces

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1 INTRODUCTION

1.1 Purpose and Scope

This document reports the design methods and software components used to design and develop the *RADIO user interfaces.*

Specifically, it describes the design and development of the 1st prototype of the *unified smart home/robot end-user interface.* The design criteria and development of the *care givers and medical personnel interfaces*, along with the final unified smart home/robot end-user interface and the users' manuals for each GUI separately will be reported in the next iteration of the deliverable (D5.5, Project Month 24).

1.2 Approach

This deliverable is prepared within *Task 5.2 Design and development of user interfaces.* The work plan in this task includes the design of three user interfaces:

1. A unified smart home/robot *end-user interface*, offering simple and intuitive control over all comfort and assistance aspects of the RADIO system. This will be used on mobile devices (smartphones, tablets).
2. A *care giver notification interface*, which can deliver alarms or other notifications over smartphone apps to the care giver. The nature and parameters of these notifications and alarms will be set by the care givers and/or by medical personnel using full PC interfaces.
3. A *medical personnel full PC interface,* through which medical personnel can manage the collection of data and the required analyses, and can receive reports with the extracted information.

This first version of the deliverable (D5.4, Project Month 12) reports the design methods and software components used to create the first prototype of the unified smart home/robot *end-user interface.* In particular it reports:

- The GUI design
- The integration to *end-user interface* of the Smart Home functionalities (EnControl web app-provided by S&C)
- The software components needed for human (GUI) -robot interaction functionalities.

Specifically, Section 2 describes the target group and design and technical requirements. Section 3 presents the mockup and actual design and comments on the customization requirements.

The second iteration of the deliverable (D5.5, Project Month 24) will report the design criteria for the care givers and medical personnel interfaces. Moreover, it will report the software components needed for receiving notifications and alarms and for setting notifications and alarms parameters and the software components needed for managing and consuming medical information.
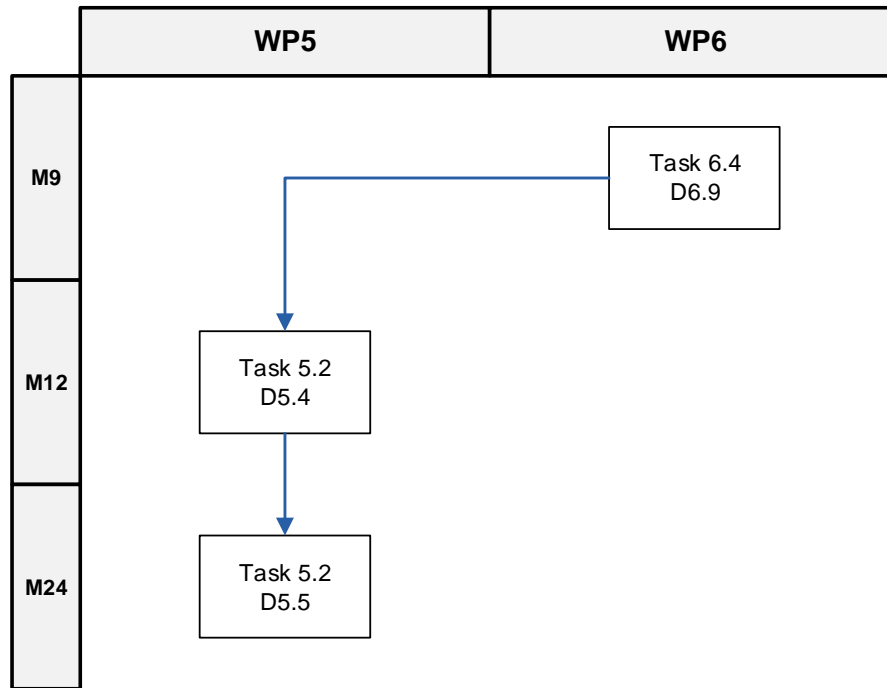
Figure 1:Pert diagram

1.3 Relation to other Work Packages and Deliverables

This deliverable is informed of *D6.9 User evaluation report I*. D6.9 provides requirements for the Graphical User Interface (GUI) of the end-user. This deliverable is in form of report setting the requirements for the first version of the RADIO end-user GUI. It will be superseded by D5.5 User Interface II that will include a) a report listing the final requirements for all GUIs prescribed in RADIO, b) user manuals for all GUI and c) GUI software.

2 RADIO END-USER INTERFACE REQUIREMENTS

This section lists the requirements taken into account for the design of unified smart home/robot *end-user interface*. We first briefly present the characteristics of the target group. We then go on by setting the User Interface requirements based on the results of Formative Phase of Usability study. We then go on defining further technical requirements.

2.1 Target Group

The target group of RADIO *primary End-Users' Interface* is the elderly people using RADIO Environment. According to *D2.1 Early Detection methods and relevant system requirements I,* the characteristics of RADIO users relevant for the *Graphical User Interface (GUI)* design are the following. The users:

1. Are older than 64 years old.
2. Are able to walk without human assistance indoors.
3. Do not suffer from moderate/severe mental disease, such as dementia, according to clinical criteria or neuropsychiatric disorders.
4. Are not blind, deaf, or having languages problems

It should be expected that a vast majority of the end users do not have experience with technology. Thus, the challenge presented here is how to design a user interface that is simple and does not require any prior exposure to technology.

2.2 User Interface design requirements

The general purpose of the *user interface* (UI) is to mediate an easy use of the RADIO environment. The usability of the entire environment depends to a large extend on the usability and acceptance of the user interface. In order to guarantee unobtrusiveness in terms of the user interface, we should present a *GUI* that bears visually friendly characteristics and has a clear and intuitive way to present and communicate its functionalities. Multistep tasks must be self-explanatory, explicit and natural, leaving no space for confusion and errors. Communication wise the interface should be polite, respectful and inspiring user's confidence. Put in simple words, the interface must be bearing characteristics similar to a human-human interaction.

Here we distinguish between three main categories of design requirements: visual, interaction and communication requirements. Table 1 lists detailed requirements pertinent to these three categories. These requirements are based on the results of the Formative Phase Usability study (Table 4, *D6.9 User Evaluation Report I).*

An extra category of requirements concerns the *customization* of the UI to the environment of the users and to individual characteristics of the users (like their voice) that will allow for event recognition.

Table 1: User Interface Design Requirements

Category	General Requirements	Specific GUI requirements from Formative Phase Usability Study
Visual requirements		
Page layout	Simple, Easy to scan, Efficient	Minimize information: Only necessary items should be provided per working page. Do not include functions that are not necessary (e.g. system configuration item).
Icons/Glyphs	Standard/Self- explanatory icons	Icon Clarity: Intuitive visual items (icon and glyphs).
Animations and transitions	Confirm what is happening visually, give feedback, draw attention to important change, or explain tasks visually.	
Text	Easy-to-read typography, concise text. Dark text on a solid light background, to allow all users to read easily.	Large text size.
Color	Neutral Colors, Use of red, yellow, and green as status indicators; globally consistent and culturally independent.	Intense color contrasts between the background and icons/text
Functional requirements		
Self – explanatory/ Consistent navigation.	Clear which action to take -proceed with the task with confidence. Straightforward tasks. Easily recover from mistakes.	Single task per page/ one key-one function. The GUI should guide the user through the steps needed in order to achieve a task. No information or options that is not directly related to the current task should be presented. The user should only be given the absolutely necessary options required for this task, and reasonable defaults should be applied in as many cases as possible.
Simple	Commands should be discoverable, direct, easy to find, contextual.	Easy access to home page. Easy return to previous page, when necessary. Direct access to the required item – No drop down lists to be included.

Category	General Requirements	Specific GUI requirements from Formative Phase Usability Study
Feedback	Confirm successful actions. Provide alternative actions if initial action was unsuccessful. Actionable errors.	
Communication requirements		
Personalization	Allow personalization of layout.	
Motivate people to use the app/ make mistakes easy to correct	Provide user guidelines	Provide a short video with the main features of the system that elderly can see to improve his confidence and solve emerging usability problems. The GUI should be able to play such short videos, ideally offering videos relevant to the current task.
Customization requirements		
Individual user's characteristics	Adapt acoustic models to user's voice	
Institutional or own residence	Map user's environment and allocate rooms.	

2.3 User Interface technical requirements

2.3.1 Radio Web application

The RADIO environment end-user interface was decided to be a Web app to allow smooth transition and integration to the EnControl application (SH functionalities). In order to avoid asking the users to access the RADIO environment app via a browser, we will embed our application into an android app that will allow direct access to it.

2.3.2 User Interface - Robot communication

The main software components that were developed to enable the UI-robot communication, besides the GUI itself, are:

a) the main controller and
b) the robot API (JSON API that bridges to ROS).

All the details concerning this softaware components and their communication will be specified in *D4.2 Architecture for extending smart homes with robotic platforms II*.

Specifically for the 'Guide me' robot function that will be used in the Intermediate Phase study (*D6.2 Pilot Planning I*), the following JSON schemata were prescribed to allow for location selection/customization and communication of the location between the UI and the main server's API :

1. addKnownLocations: This service is used to configure the system. The configuration-client is served with a set of known room types along with their icons. The json file that is sent by this service is shown below:

```
{
                "version":"00",
                "rooms":[
                  {"type":"other", "icon":"fa-key"},
                  {"type":"gym", "icon":"fa-heartbeat"},
                  {"type":"cafeteria", "icon":"fa-coffee"},
                  {"type":"myroom", "icon":"fa-bed"},
                  {"type":"dinningroom", "icon":"fa-cutlery"}]

}
```

The user (the one who configures the system) selects the name, type, icon, and location (x and y) of the room. The saved json of the smart home rooms is shown below:

```
{"rooms":
    [
    {"name":"Living Room", "icon":"fa-key", "x":"12", "y":"3.4", "id":3, "type":"other"},
    {"name":"My Room", "icon":"fa-bed", "x":"12", "y":"3.4", "id":4, "type":"myroom"},
    {"name":"Kitchen", "icon":"fa-cutlery", "x":"12", "y":"3.4", "id":5, "type":"dinningroom"}
    ]
    , "version":"00"}
```

2. delKnownLocations: This service is used to delete known locations. The user who configures the system selects from the currently known locations the one that he wants to delete. The client sends the json below:

```
{
    "ids":
    [
    {"id":"2"},
    {"id":"4"}]
}
```

3. **getKnownLocations**: This service sends all known saved (using the addKnownLocations service) locations. The saved json is shown below:

```
{
    "version":"00",
    "rooms":[
    {"id":"1", "name": "Room", "type":"myroom", "icon":"fa-bed", "x": "16.1616", "y": "8.32"},
    {"id":"2", "name": "Gym", "type":"gym", "icon":"fa-heartbeat", "x": "111.222", "y": "333.444"},
    {"id":"3", "name": "Common Room","type":"other",  "icon":"fa-key", "x": "5.6", "y": "77.8"},
    {"id":"4", "name": "Kitchen", "type":"other", "icon":"fa-key", "x": "5.6", "y": "77.8"}
    ]
    }
```

4. **radioHomeService**: This service enables the RADIO user to send various commands, like sending the robot to a room of the smart home. A json file that sends the robot to a certain point is shown below:

```
{
"action_type": "goto",
"location":{"x":"1","y":"33"}
}
```

3 USER INTERFACE

3.1 Mock up

The satisfaction of the functional design requirements is demonstrated by the mock –up of the UI, presented in Figure 2. The Home Page (Figure 2. A) is designed to contain the main RADIO environment functionalities:

a) **Smart Home (SH) functionality**. This functionality provides access to EnControl environment, enabling users to control the SH services.
b) **Guide Me functionality**. This is a robot functionality that will be used in the Intermediate Phase study (*D6.2 Pilot Planning I*). It allows the users to ask from the robot to guide them into another room.
c) **Friends functionality**. This functionality will provide access to social media and it will be available in the final prototype (developed in WP3 during Project Year 2).
d) **Other Functionalities,** related to the robot will also be available in the final version of the GUI. Please note that this command is presented just for reasons of demonstration and is not meant to provide some sort of

In the Home Page, there are only the main functionalities of the RADIO environment. In this way the users have direct access to them. The 'Options' command (upper left corner) is minimized so as to be discrete and not being confused with the main RADIO environment functionalities.

Upon choosing the 'Guide me' functionality, the users are transitioned to a page showing the rooms they can be guided to (Figure 2. B). The action to be taken here is straightforward; the user has to select one of the rooms available. A banner is always presented at the upper part of the page, reminding to the users in which functionality they are found (this features will be available in all functionalities). The 'home button' is also presented in a prominent and easily discoverable way in the lower part of the page. This gives the chance to the users to return back to the Home Page and select another functionality, in case they accidentally asked to use the 'Guide me' functionality.

Three *feedback* pop-up pages can appear after room selection. The users can be notified about three possible situations:

a) **Robot is coming.** No further actions need to be taken at this stage. The users are just waiting for the robot to guide them.
b) **Robot is busy.** This page informs the user that they cannot be served by the robot at this moment. Here, they are given the *alternative action* to call the care giver to address the issue.
c) **Already in this room.** In case that the users accidentally ask to be guided in the room they are upon request of guidance, the UI offers *a quick recovery* by this mistake by explicitly offering the action to choose
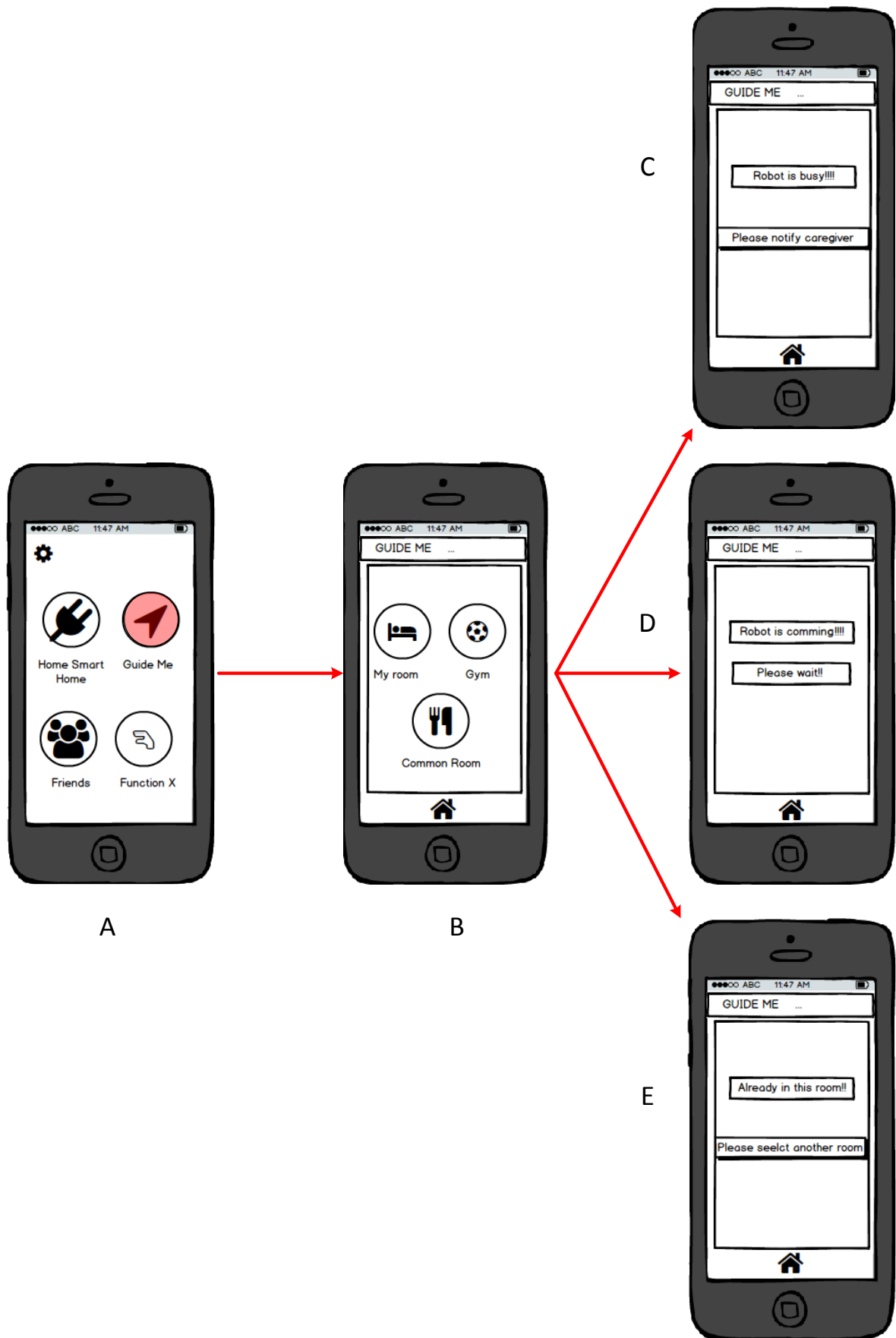
Figure 2: UI Mockup

3.2 Graphical User Interface

Figures 3 – 9 show the first prototype of the RADIO environment GUI. The background of the pages is neutral and text is dark allowing an *easy-to-read layout*. Moreover, the size of the text and the icons are large enough to further allow easy reading. The icons used are *standard* so that there is an intuitive understanding of their meaning. For the needs of the GUI we used Open Source icons provided by Fontawsome (https://fortawesome.github.io/Font-Awesome/). Text description always complements the icons for further clarity. The size of the icons and text is resizable and adjusted to the device used (smart phone or tablet-here we present smart phone captures. When the users press a command they further receive a *feedback* in the form of the color change (to green).
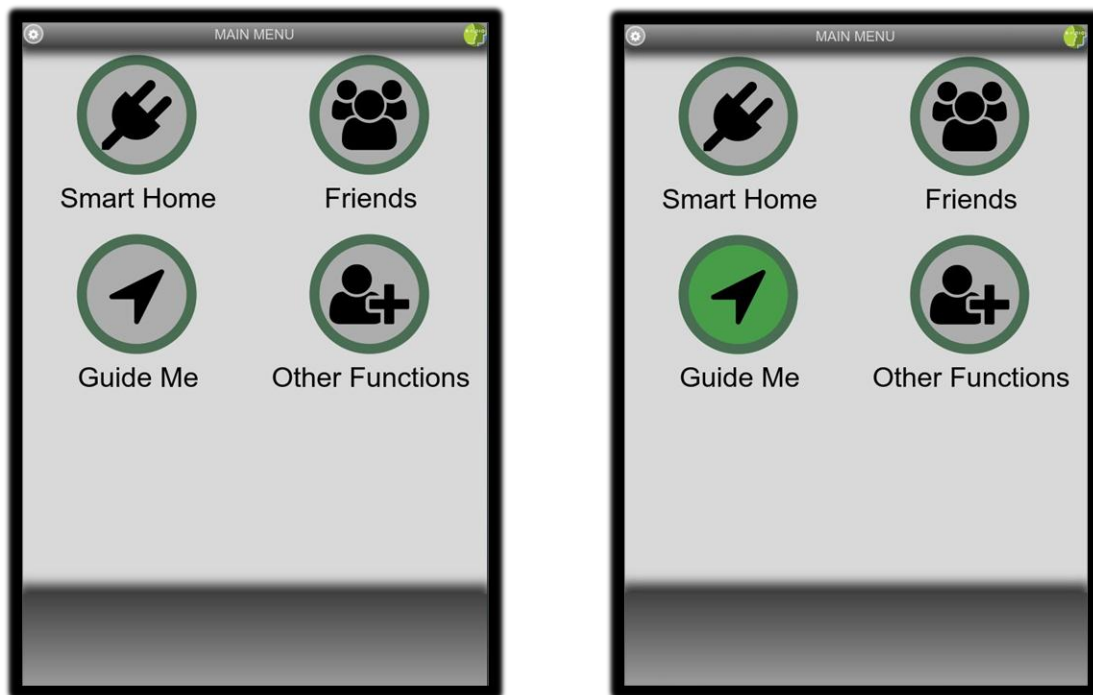
Dark text and icons allow easy- to-read layout. Standard icons are used to promote intuitive understanding of the functions provided. Text description always complements the icons for further clarity

Upon pressing the 'guide me' function, the user receives feedback in the form of color change to green.
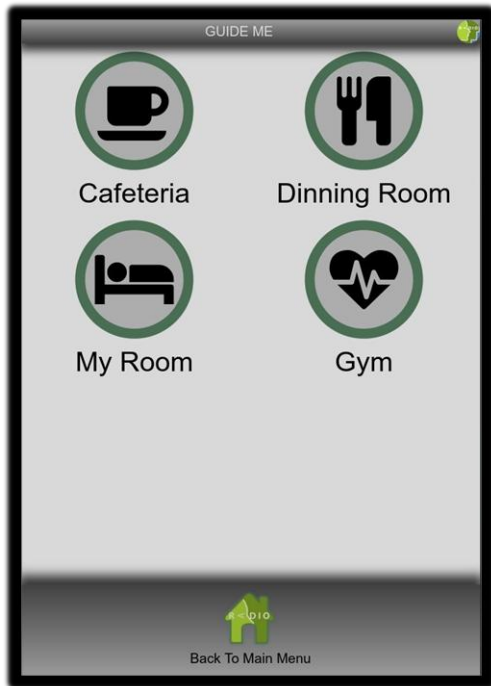
Figure 3: GUI Home Page

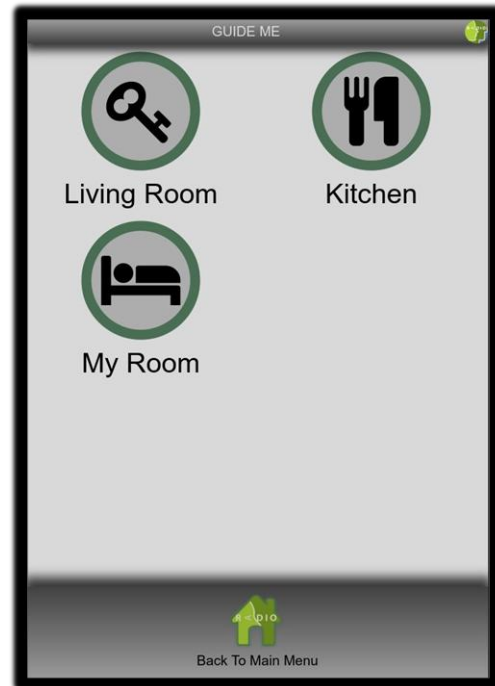*Figure 4: Guide Me page version for institutional environments.*
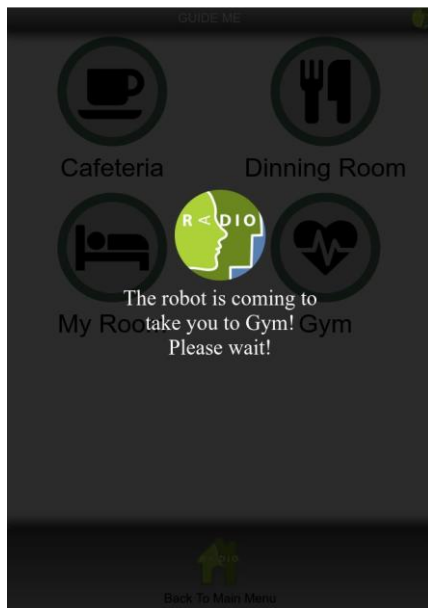

Figure 5: Guide Me page version for private residences.

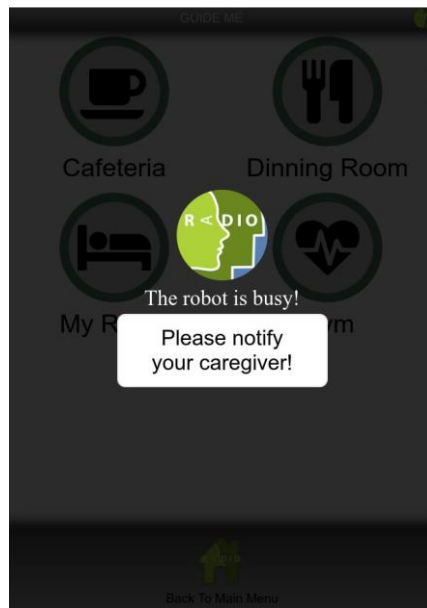*Figure 6: Feedback page 'Robot is coming'*

Figure 7: Feedback page 'Robot is busy'

Figure 8: Feedback page 'Already in this room'

Figure 9: Smart Home functionality embeds the EnControl application .

3.3 Satisfying customization requirements

In Table 1, we set a couple of customization requirements regarding the user's environment and individual characteristics. These functions will only need to be set upon installing the RADIO environment. Appreciating that these requirements necessitate a certain extend of experience with technology and in addition will only be used once (upon installation), we decided that they will not be satisfied via the end-user's Interface. Instead we will create an extra GUI dedicated to the technical personnel that will install the system.