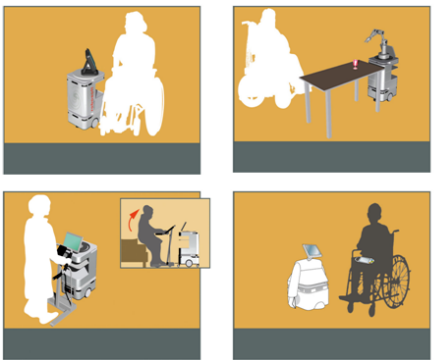
DOMESTIC ROBOT FOR ELDERLY ASSISTANCE



DOMEO Project
AAL-2008-1-159

D2.1 : Field tests and deployment methodology report

Document id: R-CHU-2_2-Field_Tests_methodology_report

Document Information	
Title	Field tests and deployment methodology report
Workpackage/Deliverable	Realist tasks scenario & evaluation methods
Responsible	CHUT
Due Date	Month 21 (December 2010)
Actual Date	05/05/2011
Type	Report
Status	Version 2_2
Dissemination Level	Public
Authors	Pierre Rumeau, Peter Mayer
Project URL	www.aal-domeo.eu

Abstract:
This report is giving a methodological frame and common language for a realistic evaluation of the products of the project with users.

Keyword List:
Methodology, taxonomy, evaluation, users, field tests.

Foreword

It will be the responsibility of the local medical leader (i.e.: the local person in charge of the protection of the volunteering prospective end-user in the project deployment phase) to cope with the ethical requirement regarding such an experiment. He must address both normative issues (ethical comity agreement, checking insurance issues and CE marking, privacy and data protection). This will not be sufficient and he will also to take into account deontology towards end-users.

Two major conditions for experiments with the home deployment of new technologies prior to any marketing are related to innocuousness and the notion of potential benefits.

Innocuousness principle means that at any time, the person in charge of protecting the volunteer must stop, delay, or alter the experiment to adapt to threats to the volunteer's health and integrity. That issue is going further than waiting for an accident (or intrusion regarding personal data and private belongings) but requires vigilance for mishaps during development, a say in some technical issues, the need to oversee the deployment. Domeo consortium has, as soon as the first robots were delivered on the sites of the partners in charge of the trials, integrated that process in its work (i.e.: lab tests without users on their premises with some level of reverse engineering and development, leading to discussion and testing of solutions before agreement within the consortium) and started assessment of the system according to the upcoming ISO 13482 standard on Safety requirements for non-industrial robots - Personal care robot. Further contact will be arranged through Andras Toth (Budapest University of Technology and Economics) between the consortium and the normalisation committee to propose them to use DOMEO project as a case study.

Notwithstanding, the innocuousness requirement ethical issue may, in fine, impact on the methodology and the level of achievement of the field tests. Domeo project partners will commit in providing a test methodology including a modular description of functionalities and use conditions to be tested so that, in any case, we make sure that valuable information can be derived from the field tests with users.

The notion of potential benefits is a major issue in the population where traditionally fearsome devices such as robots are considered[1]. Where medications are considered, ethical committees (and most countries that address medical trials in their regulations) do consider that when volunteers are experiencing, due to their condition, an acknowledgeable level of vulnerability (physical frailty, mental or psychological fragility) should not get involved in a trial; unless they themselves personally, or other people with the same condition, could

1 This is also an issue when needs are considered as it may condition different market approaches in terms of publicity to prospect opinion leaders and target prescribers (in the commercial acceptation of the term) and regarding device provision to end users (in terms of solvability optimization).

derive a significant benefit. Regarding Domeo project, though we don't provide a drug, considering we cannot balance a full certitude of innocuousness against a high probability of benefits, we must abide to that rule. Due care will be taken to take into account the special needs of the prospect end users both in terms of test protocols and test management. This statement is including the provision of the required level of medical supervision of the test for optimal user's safety. That supervision will be provided either by the local medical leader itself or, if it has not such resources, through an agreement with a care structure or individual care personnel.

Field tests model

1. Definition

The test model is aiming at proposing an ontology/taxonomy of the different field tests to provide Domeo project with a clear key to understanding the level of achievement of the project, identifying the next steps and coping with technical evolutions in the project. It could only now be completed with the availability of the Robuwalker module definitions.
It is designed at a functional level, in an operative acceptation, and not at a technical function level (also both acceptations of the word may overlap).
It will also help the AAL in assessing the work done in the project.

The goal of the field tests will be to evaluate how robotics can improve the user's situation by:

- Doubt removing in case of needed help,
- Tele-consultation,
- Socialization, through enhanced communication capabilities,

combining several sub-functions of the Domeo system according to the "Recommendations for Service Implementation and Design" as described in deliverable D1.3.

Additional information regarding practical field test description can be found in deliverable D2.2 "Generic test description file and generic test description file methodology" and will be integrated in the following test related deliverables.

2. Robumate (Kompaï) field tests model

2.1.Functional definition of Robumate regarding fields test

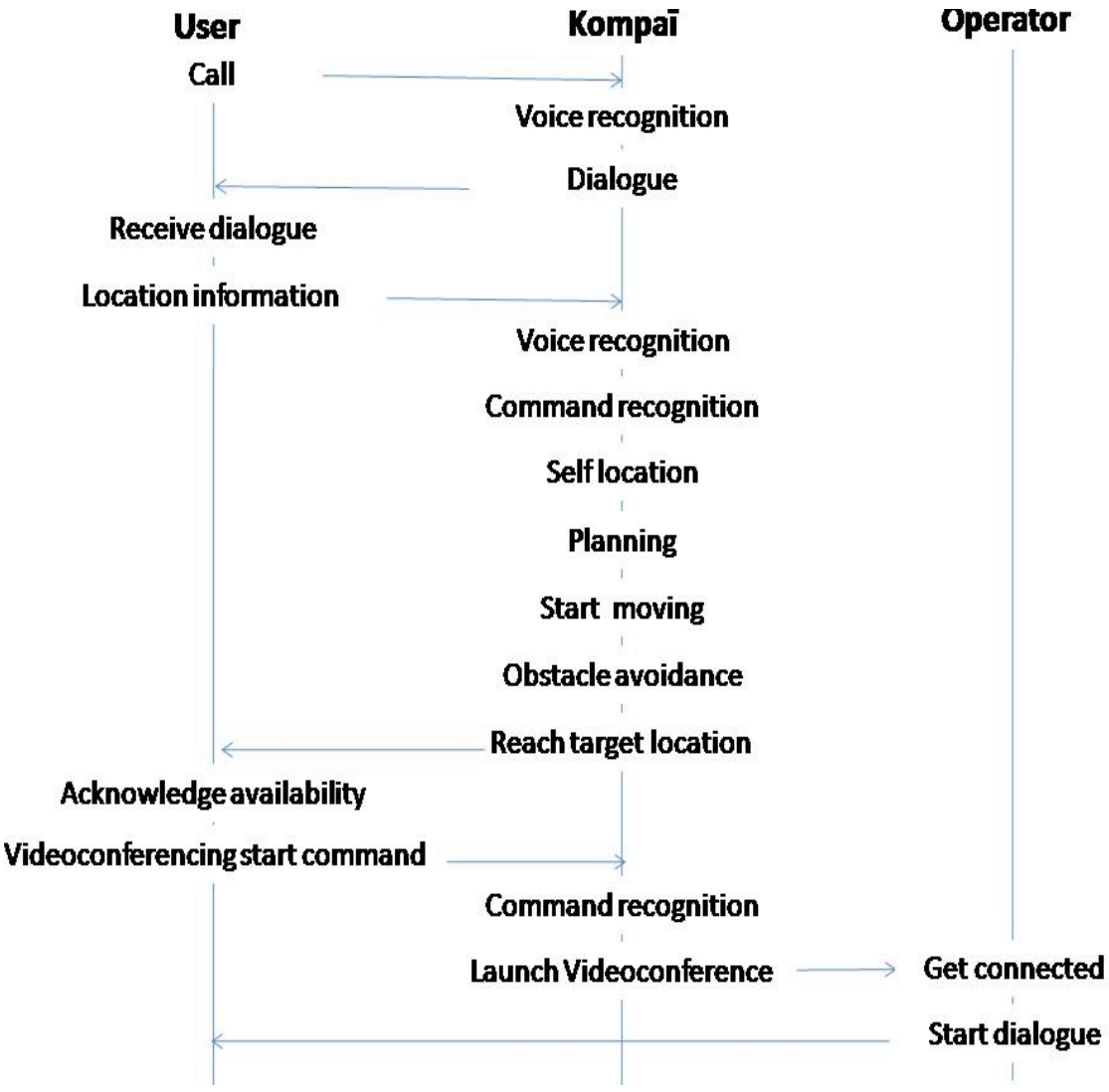
Robumate is a companion-robot with support functions (reminder, games), communication facilitation function (videoconferencing with telemedicine standards if required) and a security function (embedded-visual and videoconferencing link to a telealarm operator for appropriate reaction). The operation of Robumate is transparent to the user. Robumate is intent to be part of a service package including a remote operator providing homecare support and coordinating access to telemedicine. Robumate may collaborate with Robuwalker.

Note: alarm functionalities in Kompaï will be validated before field-testing. Because, unlike in Robuwalker, in Kompaï there is a slack link between the human and the robot without direct physical contact; alarms may be considered as purely robotic functions without direct involvement of the user.

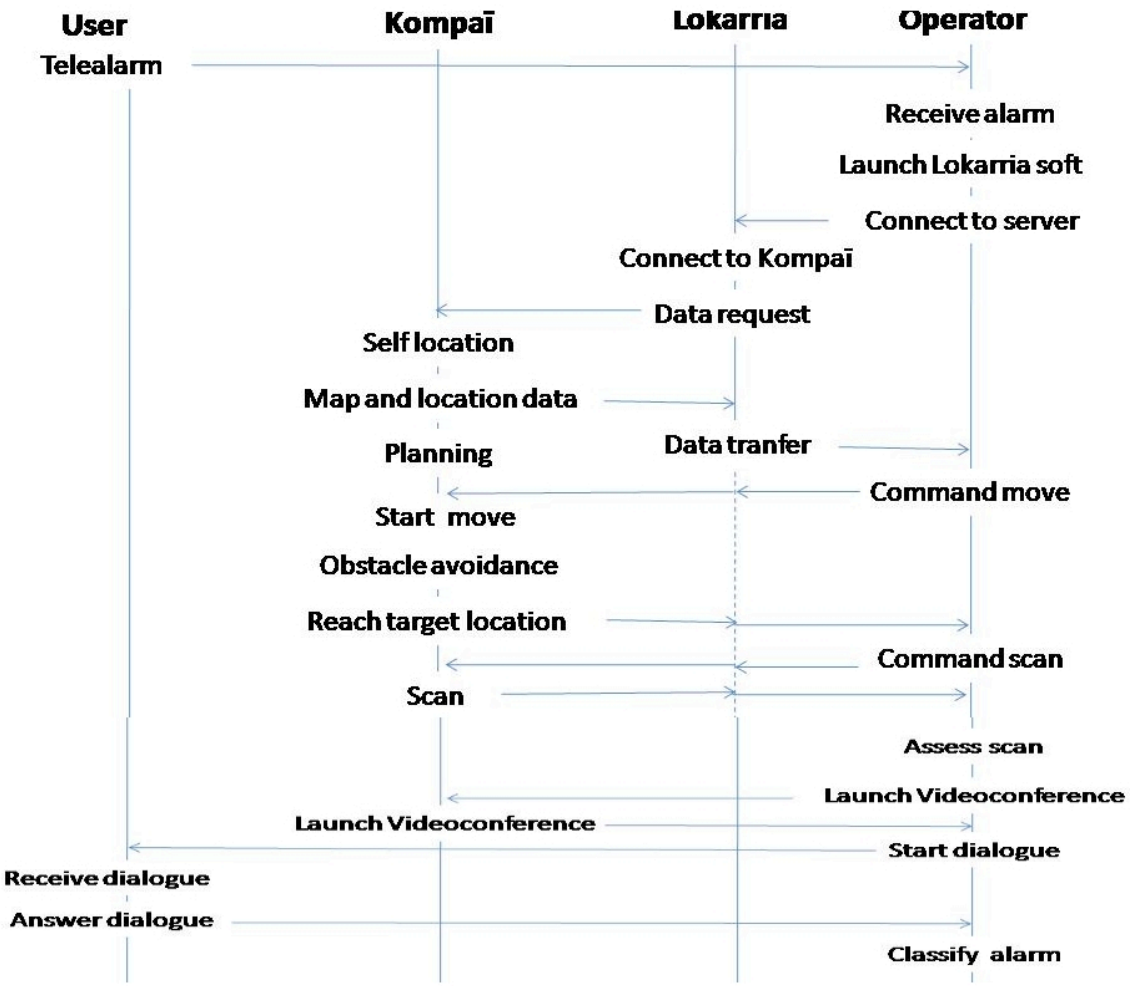
2.2.Field tests operation diagrams

Field test have to assess the main target services proposed through the use scenarios of Domeo.

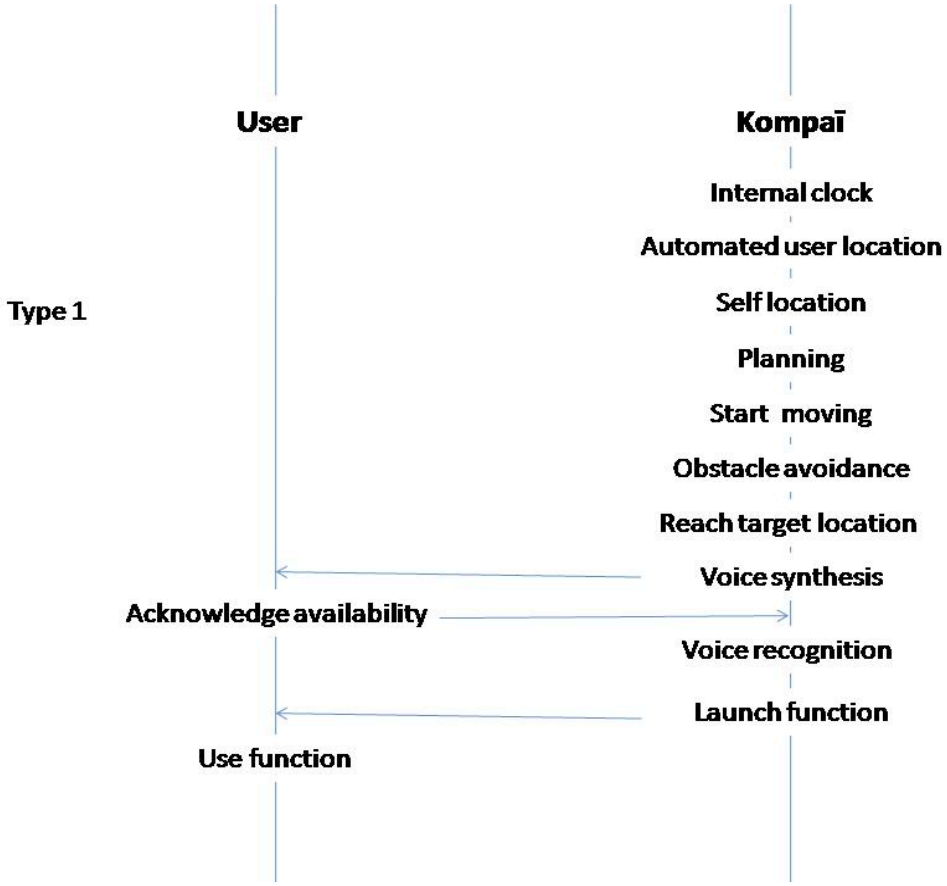
Facilitation of communication with service provision, either directly with the service call centre operator or via the service call centre operator with other services in their widest acceptation. Those will include socializing after contact through the operator and accessing to a telemedicine appointment with a physician. In the case of telemedicine, both scheduled appointments and emergency consulting will be considered.

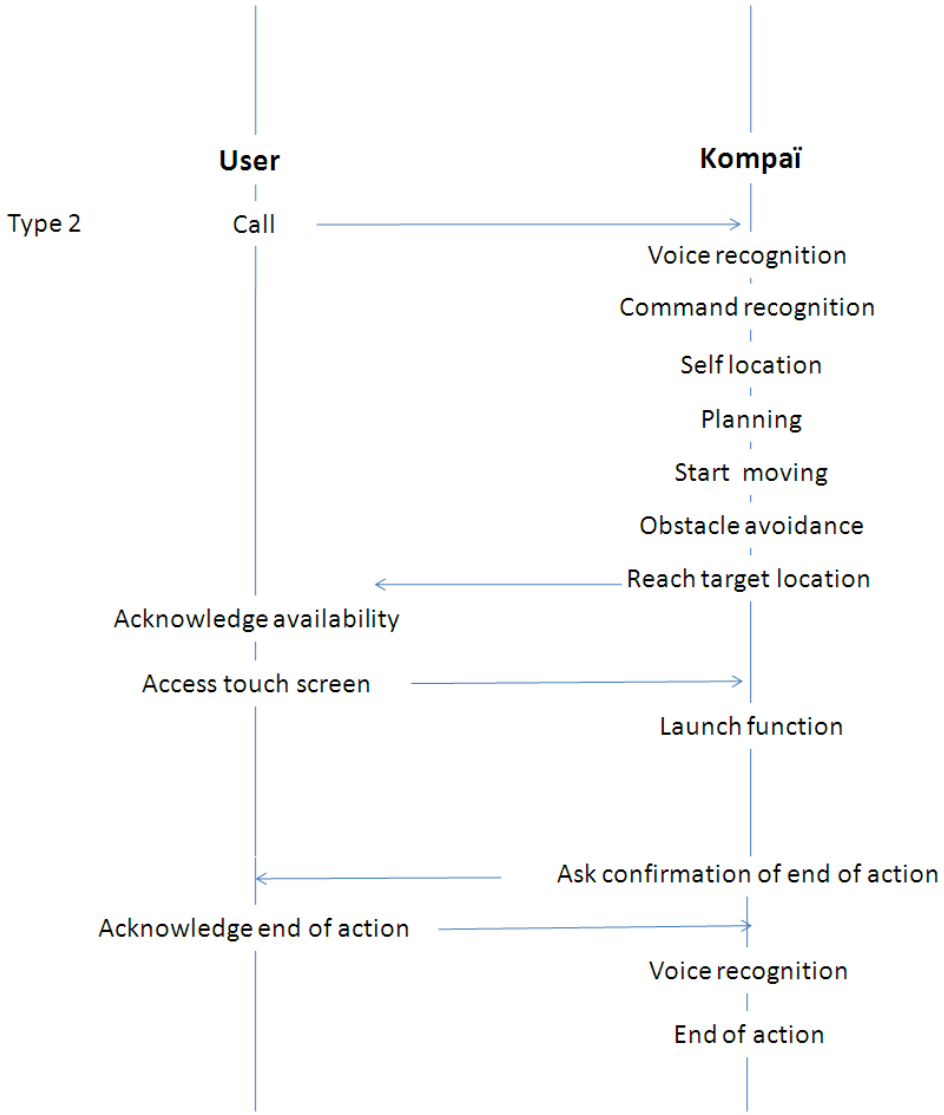


Telealarm acquitting procedures and answer proportioning. The service call centre operator will have when receiving an alarm (such as a push button pendent provided by local authorities), if the usual phone call fails, to look for the user in her (his) home, locate her (him), try to contact her (him) with the videoconferencing and asses the level of emergency. In case of need the operator will have to put the end-user in contact with the pre-agreed physician and provide an access to patient's biomedical data saved in Domeo.

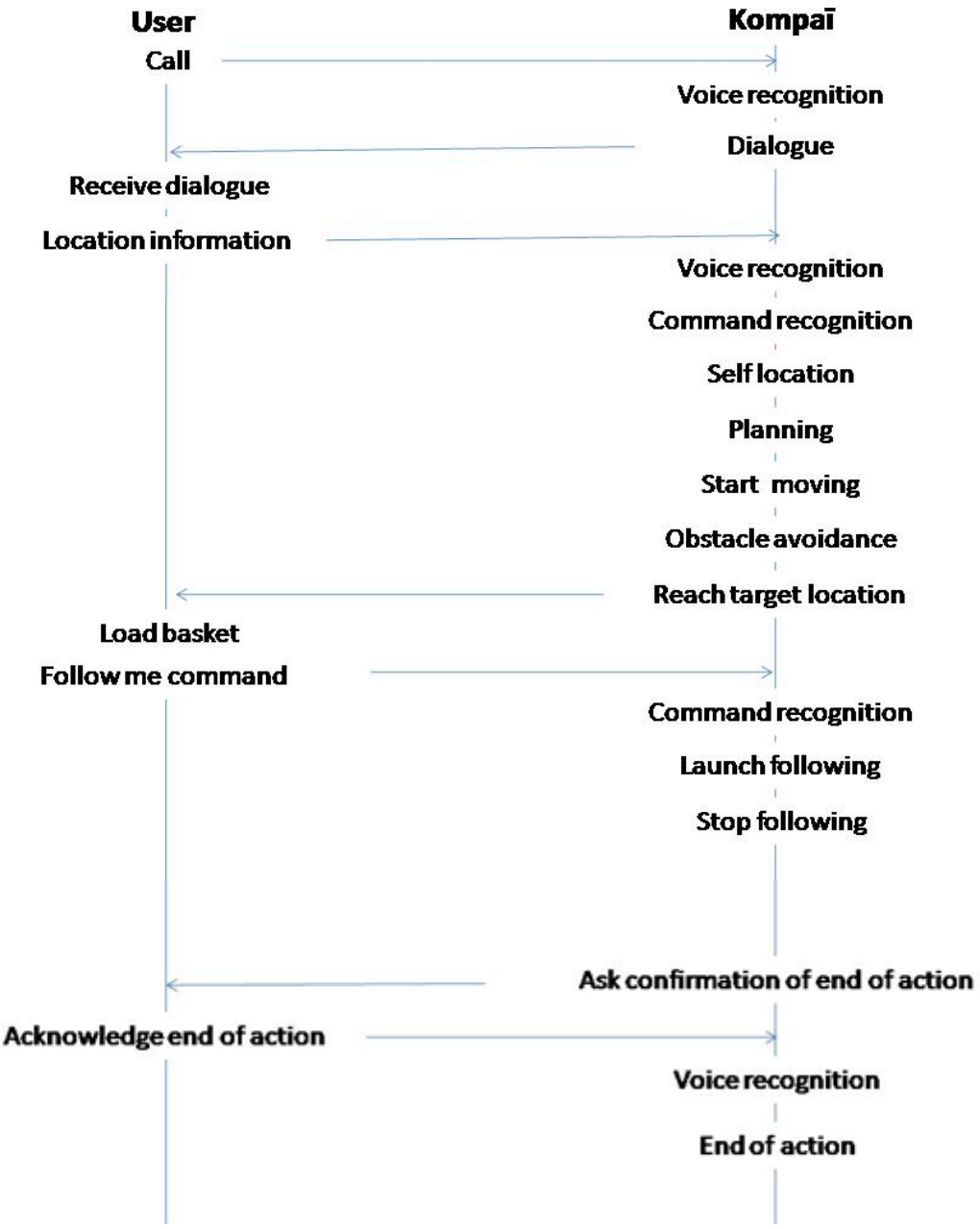


"Companioning". Robumate will have to be available to the user as a reminder for appointments or medications, provide entertainment. Some functions (type 1) such as reminders will require the robot to be in a proactive mode and assess whether the user could receive the prompting. In others, the user will ask the function from the robot (type 2).




User
Kompaï
Type 2
Call
Voice recognition
Command recognition
Self location
Planning
Start moving
Obstacle avoidance
Reach target location
Acknowledge availability
Access touch screen
Launch function
Ask confirmation of end of action
Acknowledge end of action
Voice recognition
End of action

A basket was added after the user's needs assessment in Hungary and Austria: will it be used and what for.



2.3.Taxonomy of modules for Kompaï testing

The various acronyms will be preceded of "(K)" if another device is interacting with Kompaï during the considered test.

Vocal interface = HCIV (voice)

Voice capture = HCIVinpM (voice input machine)

Voice recognition = HCIVprM(voice processing machine)

Vocal command recognition (various commands) = HCIprV (human computer interaction treatment voice)

Dialogue generating = HCIVoup M (voice output machine, not separate between processing and production)

Dialogue hearing = HCIVinpH1 (voice input human 1)

Dialogue understanding = HCIVprH1 (voice processing human 1)

Dialogue flow = HCIVrte (voice rate)

Prompting hearing = HCIVinpH2 (voice input human 2)

Prompting understanding = HCIVprH2 (voice processing human 2)

Conflict with other interfaces (touch/remote) = CCtrPry (command control priorities)

Touch interface = HCIT (touch)

Interface accessibility (visibility/reach) = HCITaxs (human computer interaction accessibility)

Interface intutivity = HCITtrH

Conflict with other interfaces (voice/remote) and main robot directory = CCtrPry (command control priorities)

Robot mobility

Selflocation = RmvtL (robot movement location)

Planning = RmvtP (robot movement planning)

Obstacle avoidance = RmvtA (robot movement avoidance of obstacles)

Follow me = RmvtF (robot movement follow me)

Energy provision (docking) = Emgt (energy management)

Moving = RmvtM (robot movement moving)

Remote command = HCICtrRte (human computer interaction[2] control remote)

Note: target location (remote/automated/semi-automated) is included in planning thanks to organisational strategies.

Videoconference

Launch user/operator = VcfOnU/O (videoconference on user or operator)

Close user/operator = VcfOffU/O (videoconference off user or operator)

Voice hearing = VcfVinpH (videoconference voice input to the human)[3]

2 Human robot interaction in its control aspects is considered as human computer interaction with the control computers of the robot.

3 Information through videoconferencing from the screen and loud speakers of the robot could be considered as a function of the robot if we were addressing an average population, without handicap. In the case of our population, due to physical and cognitive impairments, the result should be considered and not the production.

Voice capture = VcfVinpM (videoconference voice input to the machine)
Image seeing = VcflinpH (videoconference image input to the human)
Image capture = VcflinpM (videoconference image input to the machine)

Telecom

Connection Lokarria (up/down-Robot/operator) - 3G, ADSL, Satcom = CxLkU/D-3G/ADSL/Sat (connexion Lokarria up, i.e.: to Lokarria, or down, i.e.: from Lokarria, from the operator's working station, through third generation mobile phone communication, broadband or satellite communication).

Connection Robot/Operator (up/down) - 3G, ADSL, Satcom = CxVcfU/D-3G/ADSL/Sat (connexion link to the videoconferencing station on the robot up, i.e.: to the operator, or down, i.e.: back from the operator, through third generation mobile phone communication, broadband or satellite communication).

Multipoint videoconference (point to point +1) - 3G, ADSL, Satcom = CxVcf+1U/D-3G/ADSL/Sat(connexion link to the videoconferencing station on the robot up, i.e.: to the operator and one other site, or down, i.e.: back from the operator and one other site, through third generation mobile phone communication, broadband or satellite communication).

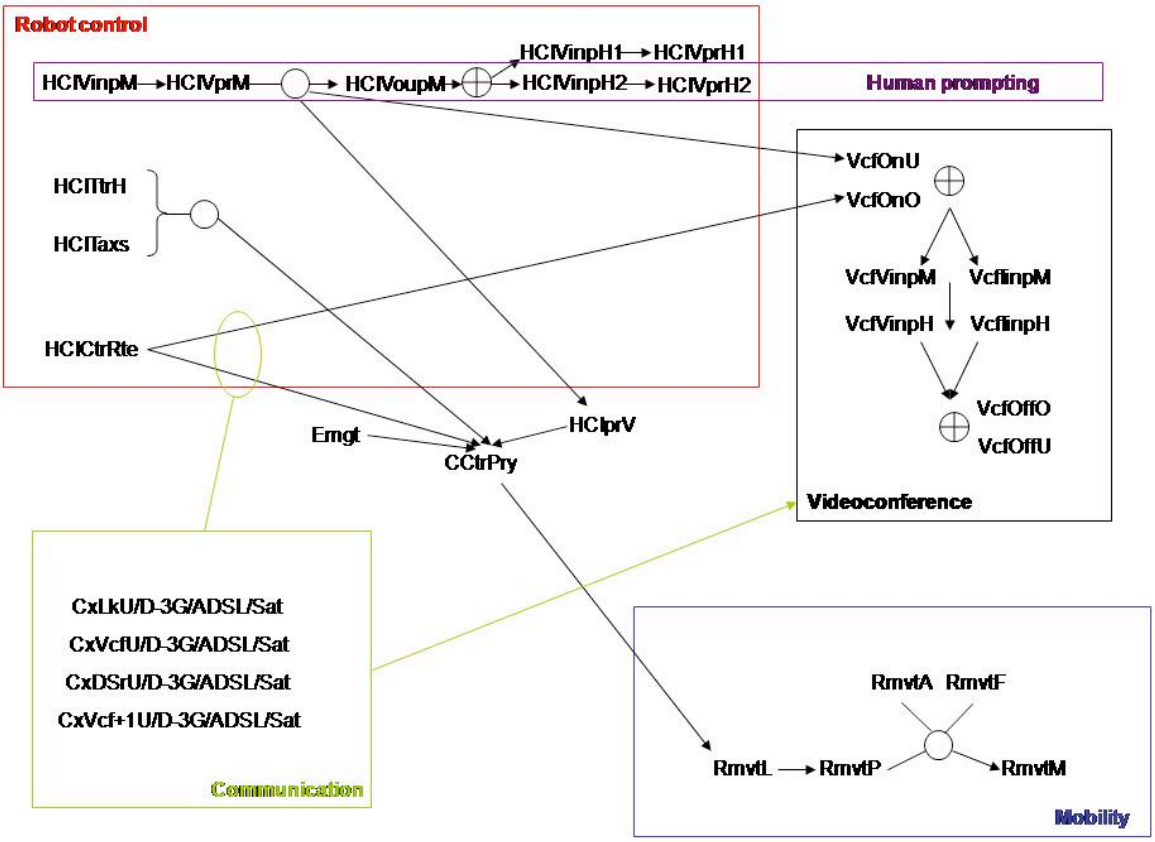
Connection to medical data saver (up/down) - 3G, ADSL, Satcom = CxDSrU/D-3G/ADSL/Sat (connexion data server up, i.e.: to medical data server from the robot, or down, i.e.: from the medical data server, through third generation mobile phone communication, broadband or satellite communication).

2.4.Scheme of the different test modules

The different test modules may be either tested as a whole function or as elements.

Three core-functions have been spared from the test meta-modules (robot control, human prompting, videoconference, communication and mobility). These are: the management of contradictory commands from different sources and related priorities, the generation of a command once the language recognition has occurred (which are part of the operation of the robot and not of the interfaces) and all the energy management including the docking station functionality (which is a functional entity by itself and should not be divided unless a degraded solution is considered as part of the risk management process).

Validation of the different modules will end in the deployment of a validation at scenario level. The detailed description of scenarios will be part of WP7 based on the aforementioned taxonomy and the following functional scheme.



3. *Robuwalker field test model*

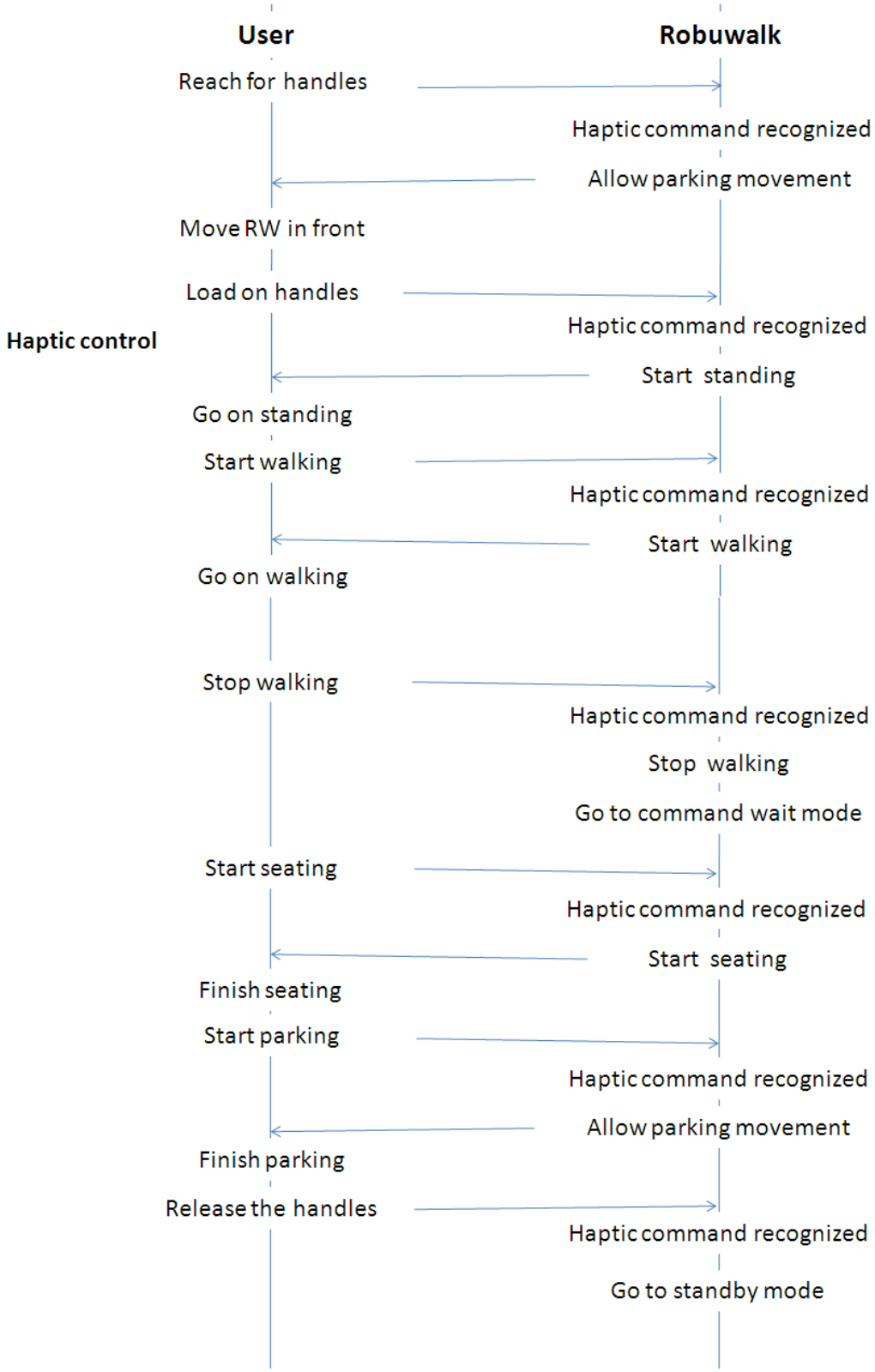
3.1.Functional definition of Robuwalker regarding fields test

Robuwalker is an intelligent walker that may help people with motor handicap stand and walk independently indoors on a level ground open space. Robuwalker may collaborate with Kompaï.

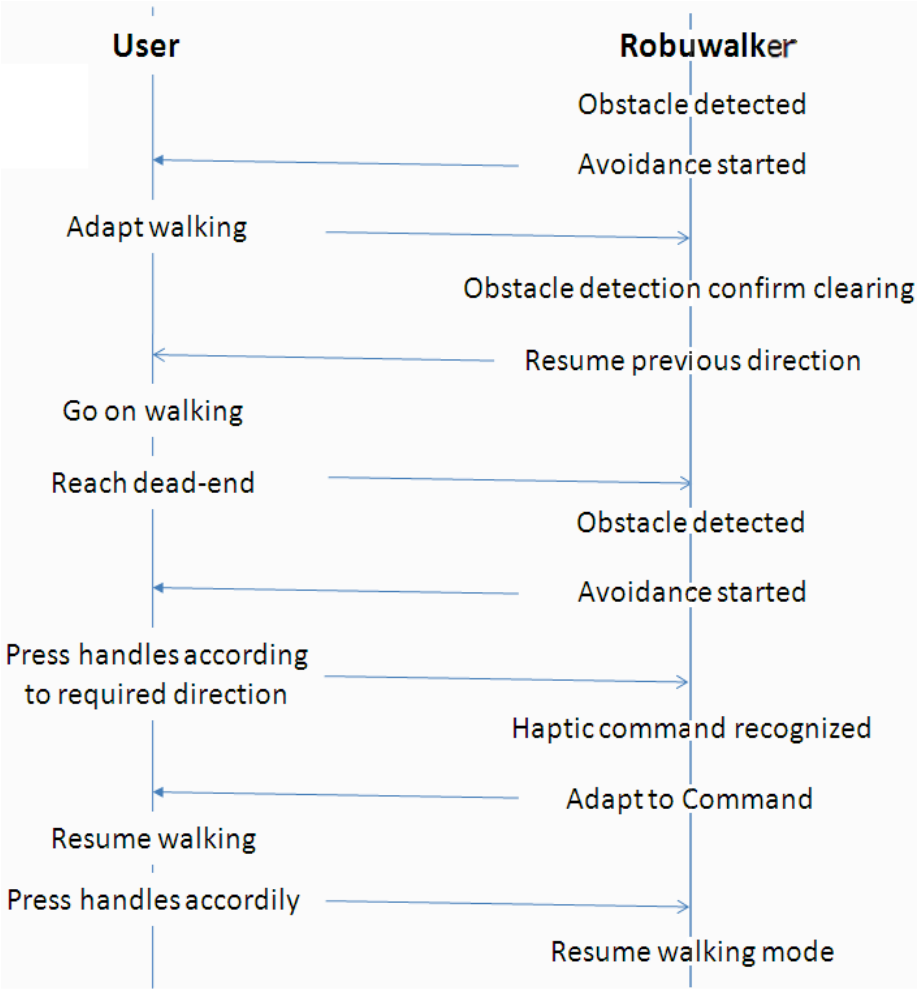
3.2.Field tests operation diagrams

Indoors moving scenario: the first and foremost role of Robuwalker will be to allow the user to move independently in his (hers) home. This will include user controlled actions: standing, seating and mixed actions with a part of adaptation by the robot: avoiding obstacles, U-turning in a cul-de-sac.

Controlled actions diagram



Mixed actions diagram including a part of automated control



3.3.Taxonomy of modules

The various acronyms will be preceded of "(W)" if another device is interacting with Robuwalker during the considered test.

Haptic Interface

Haptic capture = HCIHinpM (haptic input machine)

Haptic command recognition (various commands) = HCICprH (command processing haptic)

Haptic command alarm = HCIAlmH (human computer interaction alarm on haptic sensors)

Robot mobility

Priorities between different commands = CctrP (Command control priorities)

Moving during user's walking activity = RmvtW (robot movement walking)

Movements of the robot when user is standing up = RmvtSu (robot movement standing up)

Movements of the robot when user is seating down = RmvtSd (robot movement seating down)

Parking aside = RmvtPK (robot movement parking)

Robot movement without user (automated) = RmvtAuto (robot movement automated)

Selflocation = RmvtL (robot movement location)

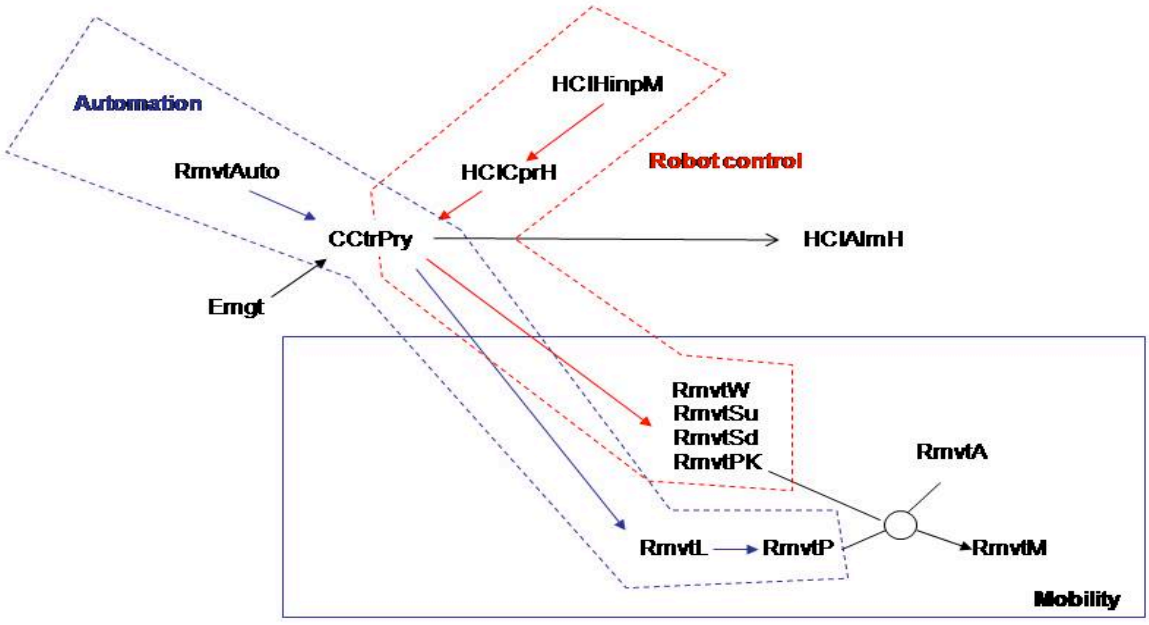
Planning = RmvtP (robot movement planning)

Obstacle avoidance = RmvtA (robot movement avoidance of obstacles)

Energy provision (docking) = Emgt (energy management)

3.4.Scheme of the different test modules

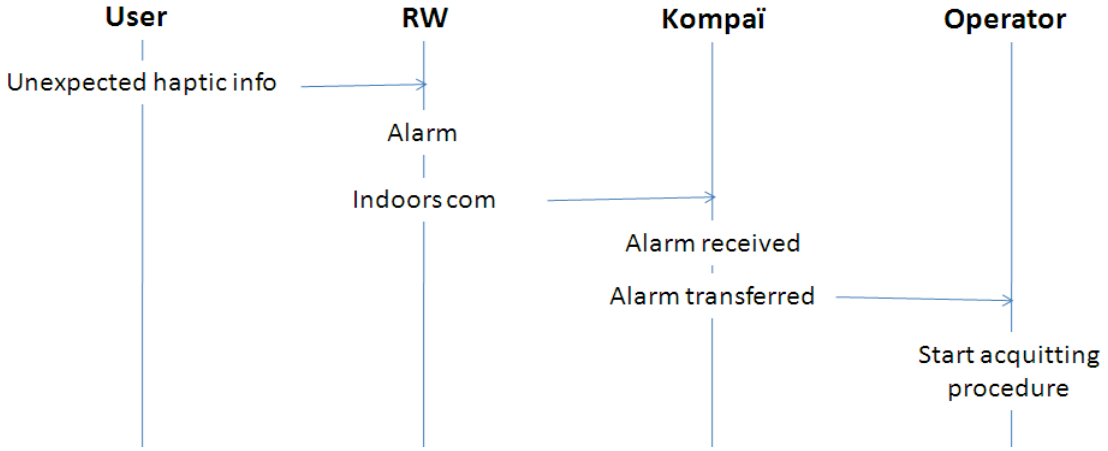
Three core-functions have been spared from the test meta-modules (robot control, automation, mobility). These are: the management of contradictory commands from different sources and related priorities, human computer interaction alarm on haptic sensors and the energy management including the docking station functionality. We consider energy management is a functional entity by itself and should not be divided unless a degraded solution is considered as part of the risk management process; that's why it is extracted from the mobility meta-module where the other mobility functions appear. Also we tried as much as possible to reuse the Kompaï modules or nomenclature, the different role of Robuwalker required to take into account the need for directly user commanded action via the haptic interface and allow them to be prioritized over automated functions if required (in Kompaï only the triggering of some functions is done by the user, then they run automatically).



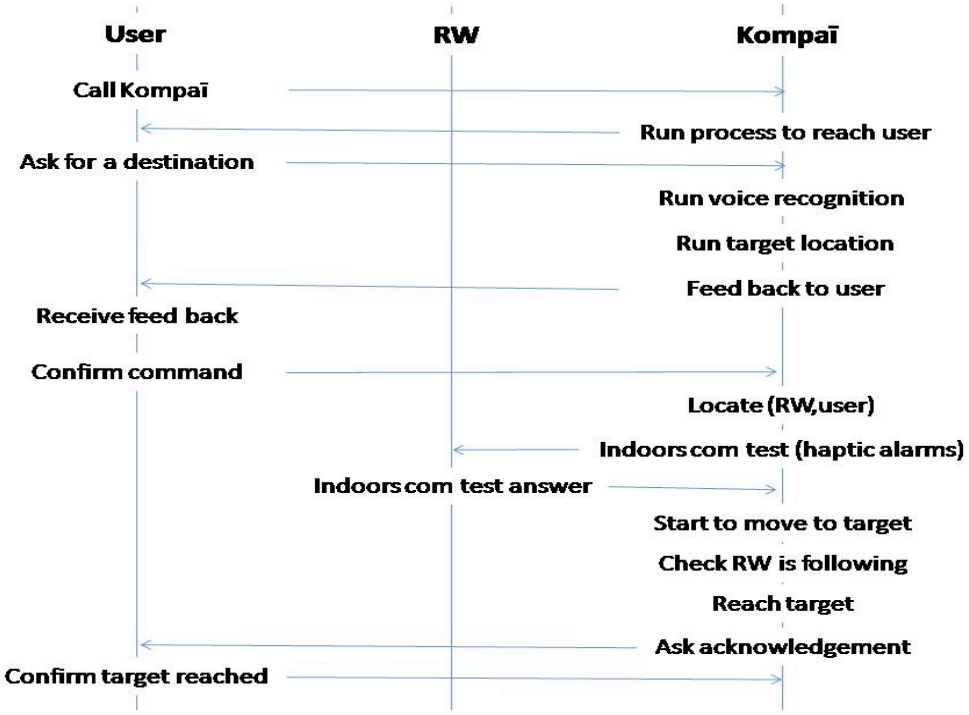
4. Collaborative (Kompaï, Robuwalker) field test model

4.1. Field tests operation diagrams[4]

Haptic alarm acquitting scenario: a trouble is detected by RW (Robuwalker) through the haptic interface. RW is sending an alarm to the operator who uses Lokarria to assess the situation.



Indoors navigation scenario: Robuwalker will collaborate with Kompaï to help the user reach a required location.



[4] As some of the processes used have already been described in detail in the previous chapters about Robuwalker or Kompaï, they will not be detailed in the following diagrams.

4.2.Taxonomy of modules

Indoors communication module between Kompaï and Robuwalker = (K)IndCom and (W)IndCom (Kompaï indoors communication and RW indoors communication)
RW haptic alarm processing = (K)HCIalmHpr (Kompaï, human computer interface, haptic alarm processing)

4.3.Scheme of test modules

As there are only two test modules a scheme is not provided. Indoors communication is necessary prior to transmission of a haptic alarm from Robuwalker for processing and outdoors transmission to the operator by Kompaï.

End note

We tried to go as far in depth into the field test process as possible, yet, as we are implementing an iterative approach over an explorative field, functionalities may change and therefore the related field-tests. Some adaptations might be introduced as a consequence of the outcomes of laboratory tests or the ethical approvals required. The final methodology and metrics will be set up as part of the WP7 work.

This deliverable may be amended and updated during the remaining duration of the project. Specific modules could be integrated or altered if so required after a consensus between the consortium and AAL.