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Field Trial Plan

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1. INTRODUCTION AND GOALS

The PETAL project aims to provide a user-centred platform able to support older adults affected by Mild Cognitive Impairment (MCI) in their daily living in order to improve their autonomy and quality of life. This platform aims to gather information on relevant events occurring in the elderly's current context, and it provides caregivers (but also elderly with some familiarity with technology) usable tools for controlling the behaviour of the appliances, devices and applications in a personalised, context-dependent manner, so as to better support the needs of the MCI elderly (and of caregivers themselves). Moreover, by using the PETAL platform, the older adults can also have the opportunity to train different cognitive functions through a cognitive stimulation application that should be regularly used.

In order to better understand the potentialities and the added value of the proposed system, we planned two cycles of field trials. We already had a first cycle of trials during the period May – September 2019. Originally, we planned for eight trials but since Bartenbach had problems in users' recruitment we had six trials in the first cycle. Now we are preparing a second, longer cycle, at M26 (for six months), which will involve eight users, and in this document our aim is to describe in more detail the plan for this second round.

In particular, this deliverable is structured into the following main sections: after the presentation of the PETAL field trial design with a short description of each main phase, we delineate the work we need to do in each of the foreseen phases, namely: preparation, pre-test user characterisation and platform deployment, training, running the field trials, post-test user characterisation and data analysis. Each phase is described in detail in a specific section. Lastly, we provide some conclusive remarks.

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2. FIELD TRIAL DESIGN

The design of the field trials covers the five main phases illustrated in Figure 1 (Preparation, Pre-test activities, Training, Filed trials, post-test data collection and analysis).

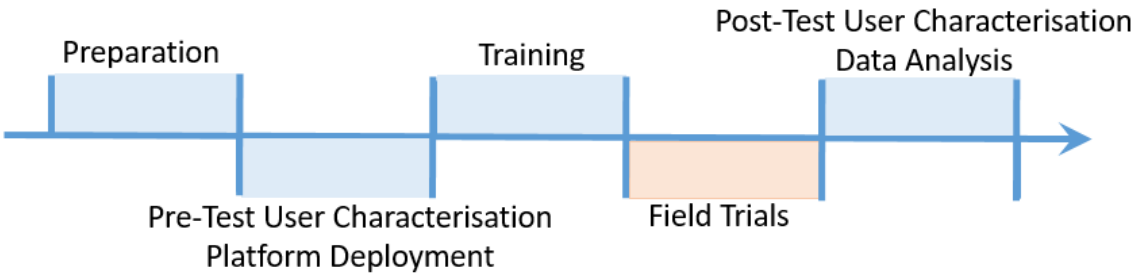

Figure 1: The main phases of the field trial design

1. **Preparation Phase.** Well in advance before running the actual field trials, we need to perform some preparation work to ensure that all the necessary elements, modules, equipment, components and even stakeholders are ready before starting the actual evaluation phase. This is exactly what will be carried out in this phase, which involves several different aspects: the selection of newly added (compared to the first round) devices/sensors/equipment and their proper integration in the PETAL platform, so as to better support users in their daily activities, and the update of some of the existing components/equipment and their proper integration in the PETAL platform. The latter is the case for example of the Kwido application, which should be updated in such a way to be able to generate additional events compared to the version deployed in the first round of trials. The Rule Editor will be updated as well, so that it can support the additional triggers that will be provided e.g. by the Kwido application or the new Minew beacons with accelerometers. In addition, still in this phase, we plan to prepare a list of possible personalization rules to include in the Rule Editor before starting the trials, to facilitate users in defining customised behaviour suitable for their needs. Users will find such rules in the public repository of the Rule Editor tool so that they can import the relevant ones in their private area and then exploit them for their own needs, with also the possibility of customising them.

   Still in this phase we have the recruitment process to find suitable participants for the field trials, according to a number of inclusion criteria we already identified in Deliverable 4.1b.

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2. **PRE-Test User Characterisation and Platform Deployment.** Once the participants to the field trials have been selected, in this phase we address their further characterisation (both for the elderly and the associated formal and informal caregivers) before starting the tests, so that the data associated with them can be better compared to those that we will collect after the end of the tests. This will mainly involve assessing the cognitive status of the MCI elderly participants as well as e.g. their current quality of life by using suitable questionnaires/tests/examinations. The caregivers' assessment will mainly cover aspects such as their quality of life and well-being. This type of characterisation will also be performed after the end of the field trials (in the Post-Trial User Characterisation phase). Still in this phase, the house of MCI older adults will be equipped with the PETAL platform and the integrated sensors, lights, devices, appliances, gateways and associated software applications, to enable its actual use by participants.

3. **Training Phase**. To support familiarization with the PETAL platform, we plan to organize two types of training, addressing both primary and secondary users: one training will involve the use of the cognitive stimulation application that the older adults will use during the field trial test; another type of training will be dedicated to the Rule Editor, which mainly targets caregivers, who will be able to create customised rules to better support the people they care for.

4. **Field Trials.** In this phase, the house of MCI older adults will be already equipped to actually use the PETAL platform and the integrated sensors, devices, appliances and associated software solutions. For this part of the project, specialized technicians will be hired or appointed by each site responsible for the field trial tests in order to provide support in case some components for some reason does not work correctly. In case they are not members of the PETAL project, they will be specifically informed about the purpose of the project and will receive a detailed description of the technological requirements for PETAL, and the home layout/map of each subject involved in the field trial test provided by the PETAL local partner. CNR will also provide remote support for this purpose during office time. The evolution of the trials will be monitored through the use of diaries by the users who will thus be able to annotate relevant events, and also with the support

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of the monitoring functionalities provide by the PETAL platform. During the trials the older adults, with the support of their caregivers, will play the cognitive stimulation serious games, create personalization rules more suitable for their needs, report on special events, keep the diary, and control that everything is functioning. For such tasks they will be supported by the local PETAL partners in charge to manage the corresponding field trial.

5. **POST-Test User Characterisation and Data Analysis.** In this phase we will aim to gather data regarding the cognitive status and the user experience of the MCI elderly participants as well as of their caregivers in terms of various aspects e.g. their current quality of life, by using suitable questionnaires/tests/examinations. This characterisation will be done to enable some comparison of the data associated with primary and secondary users before the use of the PETAL system and after the use of PETAL system, to understand whether any change in their life can be associated with such use. In this phase, we will also conduct some qualitative analysis of the impact of the PETAL platform through interviews and questionnaires. Other data that will be analysed are the repository of the personalization rules created and those triggered during the trials. The overall goal of the data analyses is to investigate on the possible effects of the PETAL system on the participants to understand favourable or unfavourable situations/conditions of application, and on possible arguments to convince future customers to buy the system.

3. PREPARATION

3.1 User Recruitment

In this phase we will recruit both MCI elderly and associated formal/informal caregivers. It is worth pointing out that a few people who participated in the previous round of the field trials will also be involved in this second round.

3.1.1 Recruitment of MCI users

In order to ensure that the PETAL platform will properly support the needs of MCI older adults, the specific lifestyles, capabilities, living environments and ambitions of MCI elderly people must be

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considered in order to find adequate concepts and solutions for the purpose of supporting their independence. In this respect, we are following a set of criteria in order to recruit as well as monitor the MCI patients that will take part in this project:

- *Diagnosis of MCI*. The diagnose is based on cognitive tests (such as MMSE, Rey's Figure, Verbal Fluency Test, QoL), thoroughly described in D4.2a.
- *Independency*. As the definition of MCI patient states, they have to be active and independent persons, although they often have more difficulty or may take longer than their normal counterparts in performing more cognitively demanding instrumental activities of daily living (IADLs) such as driving, telephone use, finding belongings, grocery shopping, medication management, food preparation, traveling alone, and handling finances.
- *Technological Literacy*. PETAL personalization rules can be directly created by the older adults themselves if they are accustomed to technology use, which can be useful also for accessing the cognitive stimulation application on the tablet.
- *Living*. Taking into consideration the system that PETAL Project offers, patients who live alone are more prone to benefit from PETAL's support (i.e. the lighting system) than those living with a spouse or another family member. In addition, living alone can also facilitate monitoring and analysis of MCI elderly's behaviour.
- *Residence*. The residence might be a flat or even a house, with only a single floor and with an area of no more than 75 sm.

3.1.2 Recruitment of Caregivers

Our consortium recognizes the importance and the valuable role of caregivers for the older adults. The target group of our project is characterized by two main categories: formal and informal caregivers. Formal caregivers are providers associated with a formal service system, who may work independently or be employed by various specialized institutions like nursing homes, institutions specialized in providing medico-social home care, non-profit organizations, charity service groups, seniors' centres and hospices. Informal caregivers are any relative, partner or friend who has a significant relationship

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with, and provides a regular and ongoing assistance to another person without payment for the care given.

The caregivers, both formal and informal, are selected based on a set of criteria:

- *Experience*. Previous experience in dealing with MCI or other neurological patients is required.
- *Technological Literacy*. Although the Rule Editor does provide an intuitive and easy to use platform, a minimum level of technological literacy is required in order to properly manage and use the Editor as well as to use the tablet and the smartphone.
- *Motivation*. Willingness and desire to be involved in testing the features and the support provided by the PETAL Platform.

3.1.3 Identification of the Local Contact Team

In order to deploy and use the PETAL platform in the various houses involved in the field trials, for each pair of subjects (MCI patient and associated caregiver) of a specific field trial, a special team will be responsible during the entire cycle of the field trial test. The team will be composed of a computer technician, a psychologist or an equivalent medical doctor, and a contact person. The technician will handle all the technical aspects associated with the installation and configuration of the PETAL platform in the house (e.g. setting/configuring Internet Wi-Fi, Bluetooth connections, tablet, sensors, light system), while especially relying on the help and the support of the PETAL technical members (CNR, Ideable). The psychologist (or an equivalent medical doctor) will be in charge of supporting the MCI patients and their caregivers with special attention to their needs and difficulties. Finally, the local contact person will supervise the entire cycle and will be in contact with the end-users for all possible questions and requirements that may rise up during the use of the platform.

3.2 Sensors, Appliances and Devices Selection

In this second round of the field trials, we will use the majority of elements already used in the first phase. Therefore, in this section we describe only the elements that we plan to change (i.e. removed, added or updated) compared to the configuration used in the first round.

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Compared to the list of elements that have been listed in Deliverable D4.2.a, the only device that may no longer be considered in the second round of the trial is the smartwatch (LEMFO LEM7 Android 7 Smart Watch), whose main goal is to locate the users in the home and also collect some physiological data about them. However, that smartwatch was not much appreciated by users involved in the first round, one of the main motivations was that it needed to be recharged frequently. The reason is that the device has to keep open at the same time communication through both Bluetooth (to identify nearby beacons, and thus the user's position in the home), and Wi-Fi (to communicate the user's position to the platform so that the active rules can be executed accordingly). For this purpose, we are considering the use of a different smartwatch, namely the Amazfit smartwatch, (detailed in Section 3.3.3). Another possibility would be to use a smartphone (mainly held in the user's pocket while at home).

3.2.1 Amazon Echo

In the second round of the field trials we plan to provide the possibility to have speech-based interaction between the user and the system, as well as have to have the possibility that users receive some vocal feedback from the PETAL system. To this regard, we plan to exploit an Amazon Echo device, a hands-free speaker and virtual assistant device that interacts with end users via the Amazon Alexa cloud-based voice service, and therefore enables the Echo device to "listen" for user commands to perform several types of tasks, typically including playing music, answering questions, creating and editing to-do lists and setting a timer or alarm. In the context of PETAL we plan to use this device in two main ways: i) for supporting an additional channel for providing users with (voice-based) feedback i.e. alarms, reminders and notifications (therefore in this case it will mainly support *actions* potentially triggered by the PETAL platform); ii) for providing users with the possibility to enter vocal input (e.g. to communicate the current mood) that, when recognized by this device, can activate further actions according to possible rules specified in the Rule Editor (i.e. in this case the vocal commands will act as *triggers*, according to the trigger-action paradigm exploited in PETAL).

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3.2.2 GREAT Luminaire

The problems encountered in the first round of trials concerning the stability of the communication between the GREAT luminaire and the luminaire controller have been analysed in depth by Bartenbach and the product development partners. Two possible reasons for the unstable connection were found, the solution to these issues will now be implemented by the Swiss manufacturing partner. Both of them are directly related to the communication between the controller programmed by Intefox and the luminaire itself, which was programmed by emt.

- Potential issue 1: The software running in the GREAT luminaire was designed in a way to ensure a full execution of transitions between different light scenes in order to prevent unexpected behaviour. However, this software design resulted in blocking tasks, which are now preventing the execution of commands which are sent to the luminaire during the execution of those blocking tasks. As to our current knowledge, there has already been developed a potential fix for this issue by Intefox which is provided as a system update. The bugfix includes a status ready query and some delay before sending the next command, which resulted in much more stable communication between the two devices. Changing the existing software design in the GREAT luminaire itself was discussed, but does not seem as an appropriate solution, as a fully new software development would consume too much time.
- Potential issue 2: The communication between the controller and the luminaire is based on the EnOcean protocol and appropriate EnOcean hardware components. The receiver within the luminaire features an antenna, which was led through the luminaire housing to ensure reception. In earlier versions there have been problems with the attachment and routing of this antenna, resulting in a reception quality loss which lead to an unstable transmission of commands between the two components.

Based on these two potential issues, following fixing procedure will be applied:

- All luminaire controllers will be checked for the appropriate software version. It is currently assumed, that the right version is installed and the problems should therefore not arise due to missing updates. However, if the controllers are not up to date, they will be updated to be ready for a deployment in the second round of field trials.

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- All luminaires hardware components related to communication will be checked for a proper connection. All antennas will be re-routed in order to ensure a proper reception of the luminaire heads.
- The software updates of the controllers will make it necessary to reconfigure the light switchers in order to operate with the new software version. All switchers will be reconnected to the luminaires in order to guarantee functionality.
- All luminaires will be intensively tested related to a stable communication in various settings with different distances before redeployment.

As such, the GREAT luminaire should be available for use in the second round of trials.

3.2.3 AMAZFIT Smartwatch

As mentioned above, we have analysed the feedback collected from the users who participated to the first round of trials. Some users commented that the weight and the battery life of the adopted smartwatch were problematic. For this reason, we decided to investigate new opportunities in the current technological offer, to see whether there is some product in the market that satisfies our requirements (support of Wi-Fi and Bluetooth at the same time) and has better performances. We focus on smartwatches able to communicate both using Bluetooth and Wi-Fi, because we need the Bluetooth for detect the Estimote Beacon presence placed inside a room and the Wi-Fi channel in order to send such information to the Context Server; moreover, we also need a long-life battery. Another requirement was related to step counter and heart rate sensors presence. After several investigations we concentrated on the recently presented AMAZFIT Stratos 2 smartwatch, which is supposed to have a battery lasting up to 5 days, and also provides some data associated with user's activity, as it is able to automatically track e.g. daily steps and heart rate.

We tested it for different days and with different configurations and it revealed itself inadequate since the operating system is a Xiaomi branded version of Android with fewer configuration opportunities, e.g. it is not possible to set the "Send data in background" setting. Moreover, the main communication channel used by the smartwatch is the Bluetooth one, which is used to synchronize the smartwatch with the official application installed on a smartphone; on the other hand, the WI-FI communication

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channel is used just to update the smartwatch's operating system. For this reason, the WI-FI connection is automatically shut down by the operating system as soon as the screen is turned off. We had several conversations on the XDA Forum (https://forum.xda-developers.com/smartwatch/amazfit#romList) where developers of applications for the Amazfit Stratos can discuss the typical issues they have to face during the development. One proposed solution is an application called PaceOn (https://forum.xda-developers.com/smartwatch/amazfit/app-paceon-amazfit-pace-screen-long-want-t3700247) which keeps the screen on to avoid the WI-FI shutting down by the Operating System. Thanks to this solution we have been able to send data about the user proximity to the context manager for about 7 hours. This result is similar to the battery duration obtained with the LEMFO7 smartwatch. Moreover, the PaceOn application is a standard application which sometimes is stopped by the smartwatch Operating System to limit battery consumption; when the PaceOn application is stopped then the WI-FI communication is shut down and our context delegate is no longer able to send data to the context server. We made another test by removing the communication through WI-FI on the context delegate. In this case, the context delegate exploits only the Estimote Proximity SDK (the library provided by the sensors' vendors to facilitate communication with them) to get the user position inside the house and it does not send anything to the context server. This test has been made to understand if the abnormal battery consumption was caused by the WI-FI communication or by the Estimote Proximity SDK. The results of this test have been surprising. In general, the Amazfit Stratos smartwatch without any external application remains up for 4 days, while with the proximity delegate installed (without any external communication through WI-FI) the smartwatch battery lasts about 24 hours. Thanks to these tests we realized that the cause of battery consumption is mainly related to the Estimote Proximity SDK and it is not related to the WI-FI communication. Following the data observed during these tests, we are considering to no longer use the Estimote Proximity SDK, and implement by ourselves a library which exploits the Bluetooth signal to determine the user position inside the house, in this way we expect to improve the battery life of the smartwatch (either LEMFO or Amazfit). Alternatively we can consider the smartphone solution (which has other types of limitations).

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3.2.4 Murata Bed Sensor

Ideable is already using this device for detecting bed occupancy and even breath and heart rate, so we can connect with lights when getting up or entering on bed, but also create specific alerts if something may be going wrong related to the health status of the person.

Murata SCA11H (see Figure 2) is a bed sensor, which, apart from bed occupancy, detects heart rate (bpm), respiration rate (rpm), relative stroke volume (µl) and heart rate variability (ms) in real-time. All these big data will be processed to detect different emergency situations and health problems. Ideable will implement the context delegate for this sensor in order to ingrate it in the platform.

This device can be really relevant, from a business perspective, to test it in order to be implemented in nursing homes. IDE is receiving inputs about using a night version of PETAL not only for activating lights at night in nursing homes but also to raise alerts in some potential dangerous situations. Nights are periods of the day when professionals less check the status of the end-users, so a tool like this is twice useful, not only for preventing accidents by the use of lights, but also for raising alerts when they happen.

Figure 2: The Murata SCA11H Bed sensor

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3.2.5 Minew Beacons with Accelerometer

Ideable is also willing to test Minew beacons with accelerometers in this second round of trials, that may give us interesting information about the "use" of objects. The idea is to use beacons stuck to different objects at home to detect their movement, and their use.

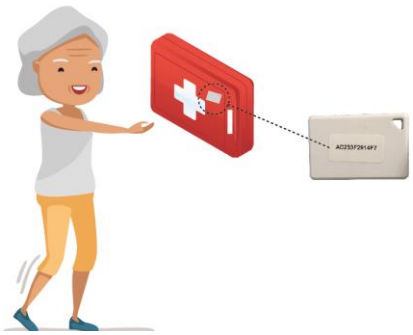

Figure 3: An example scenario of use for the Minew Beacons

For example: using the cupboard for medicines, using the TV Remote control, detecting the use of the walker used by elderly people, or the movement of a door for the shower, or the opening of the fridge door, etc. All the information for the beacons is gathered by the Minew gateway device in order to communicate it with the PETAL gateway and send it to the cloud.

Figure 4: The Minew Gateway Device G1

There is a Bluetooth Wi-Fi IoT Gateway Device Minew G1 (Figure 4) to receive the BLE signal from the sensors and send it to the PETAL gateway.

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3.3 Kwido Application Integration

We plan to extend the set of events generated by the Kwido application that will be communicated to the context server. In this way the rule editor will be able to include such Kwido events in the list of triggers that can be used to create personalization rules that connect them with corresponding actions involving the use of lights or reminders.

The idea is to better integrate the using of Kwido Mementia and the lights, for closer and more effective interaction. Some examples of the new rules and integrations planned:

- Connecting the emotional status reported in real time from Mementia with the using of lights, especially for combating low emotional status situations.
- Changing the lights to get the user more active when they start playing Kwido Mementia.
- Using green colours after a successful session playing Mementia or a more encouraging combination of colours in the case of playing bad during a session, for cheering up the users.

3.4 Rule Editor Updates

The Rule Editor underwent a number of updates before being used for the second round of field trials. One of the most relevant ones was the addition of a number of predefined rules in it. Indeed, in order to facilitate the participants in the field trials to build relevant rules, we judge it useful to provide them with a list of pre-defined rules which will be included in the public repository of the Rule Editor: therefore, users will find them whenever they access the tool. If users find some rule that can be relevant for their goals, they can select them and import them in their private repository. Such rules can then be used as they are, or alternatively, they will be customised by users to better match their own needs/requirements. The rules have been identified by PETAL members to better support the needs of the MCI elderly and also consider caregivers' needs (i.e. decrease caregivers' burden). They have been grouped under different categories in order to facilitate their retrieving, use and reuse (see Table 1). It is also worth noting that some rules can be classified under more than one category.

Support structure of elderly's daily activities /

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Improve circadian/sleep-wake rhythm of the elderly
• If there is no motion in the bedroom between 7 a.m. AND 8 a.m., start the activating light scene • IF time is between 9 p.m. and 11 p.m. turn on the living room colour light and set its colour to orange • If the elderly is at home turn on the biodynamic light • When it's 3 p.m. AND the elderly is in the living room, turn on the relaxing scene in the living room
Alarms (SMS/mail/app notification)
• If a medicine has not been yet taken between 3p.m. and 4 p.m., send an SMS to the elderly to signal this • When the heart rate is more than 100 bpm, turn on the relaxing light, then send a SMS to the caregiver • If the elderly has been in the bathroom between 11 p.m. and 7 a.m. for more than 20 minutes, send an SMS to caregiver
Alarms (light-based) • If a medicine has not been taken yet between 3p.m. and 4 p.m., turn on a coloured red light for 1 minute to signal this
Reminders to elderly
• When it is 2.30 p.m. remind the elderly to take the medicine • If today the weather is good AND it is between 9.30 a.m. and 11.00 a.m., remind the elderly to go outside for a walk • At 5 p.m. of day X remind the elderly about the appointment with the doctor on the day after • At 10 p.m. remind the elderly to recharge the smart device • When user's Kwido last connection time is more than 48 hours OR training time is less than 15 minutes, do send a reminder to the elderly to train more
Automatic actions for supporting elderly
• If the elderly is in the living room AND it is dark there, turn on the white light • When the elderly arrives home, turn on the entrance light • When the elderly exits home, turn off all the lights • When the elderly enters the kitchen, turn on the light in the kitchen • When the elderly exits the kitchen, turn off the light in the kitchen • If the elderly is in the bedroom AND it is between 11p.m. and 6 a.m., turn on a dark light in the bedroom • Turn off all the lights at 6.30 a.m.

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Notifications to elderly
• If outside starts to rain AND the elderly is in the living room, turn on the light colour of the living room for 10 seconds and set it to blue
Support elderly's spatio-temporal orientation
• When there is motion in the bedroom AND it is between 2 a.m. and 6 a.m., turn on the light strip in the corridor for 5 minutes
Improve elderly's visual comfort
• When it is 6.30 p.m. and the elderly is in the kitchen AND in the kitchen it is dark, turn on the kitchen light and set it to white
Encourage/Improve elderly's healthy lifestyles **Encourage Elderly's Physical activity**
• If the weather is good AND it is between 9.30 a.m. and 11.00 a.m., remind the elderly to go outside for a walk • If tomorrow forecast are clear sky AND tomorrow temperature is more than 20 degrees, when it is 6 p.m. remind the elderly to go outside for a walk tomorrow • When it is 12 a.m. AND the number of steps already taken by the elderly is below 1000, send a reminder to the elderly encouraging him/her to do more physical activity
Encourage elderly's social activity
• If tomorrow forecast are clear sky AND tomorrow temperature is more than 20 degrees, when it is 6 p.m. remind the elderly to call a friend to go outside together for a walk tomorrow
Encourage elderly's cognitive activity
• When user's Kwido last connection time is more than 48 hours OR training time is less than 15 minutes, do send a reminder to the elderly to train more • When user's training result is "not progressing" send a message to encourage the elderly
Improve emotional status of the elderly
• When user's emotional state becomes sad, start the activating light scene • When the elderly's emotional status becomes sad, notify the caregiver and encourage him/her to call the elderly
Caregiver's awareness
• If the elderly is out of home AND it is after 7 p.m. in the evening, send an SMS to caregiver • When elderly's Kwido last connection time is more than 72 hours, do send an email to the caregiver • When the elderly's emotional status is sad, notify the caregiver and encourage him/her to call the elderly

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• If the elderly has been in the bathroom between 11 p.m. and 7 a.m. for more than 20 minutes, send an SMS to caregiver • When the heart rate is more than 100 bpm, turn on the relaxing light, then send a SMS to the caregiver
Reduce Caregivers' Burden
• When it's 10 a.m. of day <X>, send a reminder to the elderly and to the caregiver to remind about the doctor's appointment on the following day

Table 1: The list of pre-defined rules in the Rule Editor, grouped according to their main objective

4 PRE-TEST USER CHARACTERIZATION and PLATFORM DEPLOYMENT

4.1 MCI Elderly Assessment

4.1.1 Neuropsychological battery

As in the first round of field trial, all the older adults participating in the second round will undergo a neuropsychological battery similar to the previous one. The global cognitive level of patients will be evaluated through the Mini Mental State Examination (MMSE; Folstein et al., 1975). The 22 items that make-up the scale roughly evaluate the spatial and temporal orientation, the short- and long-term verbal memory, the language and the constructive praxia. The MMSE is extensively used in clinical and research settings to measure cognitive impairment. It is also used to estimate the severity and progression of cognitive impairment and to follow the course of cognitive changes in an individual over time; in particular, a score below 23 is generally indicative of a cognitive decline compatible with the diagnosis of dementia. These characteristics makes the MMSE a good measure to describe the development of the disease in a global way.

For a more detailed assessment of the individual cognitive domain we will use a battery of tests specifically designed to diagnose dementia in elderly people, the Mental Deterioration Battery (MDB; Carlesimo et al., 1996). The MDB is composed of eights tests four of verbal material and four of visuo-perceptive material. The cognitive areas investigated by the battery tests are short and long-term memory, language, logical-deductive reasoning, constructive praxia and executive functions (a set of

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cognitive processes that are necessary for the cognitive control of behaviour and that involve the prefrontal cortex (PFC).

In particular, the following tests extracted from the MBD can be administered to MCIs:

- Rey Auditory Verbal Learning Test with immediate and delayed recall (Rey, 1958; Carlesimo et Al., 1996): for the evaluation of the short and long term episodic anterograde memory;
- Copy of freehand drawings and Copy with programming elements (Hécaen, H & Assal, G., 1970): to evaluate the simple constructive praxia and executive functions;
- Raven's Progressive Coloured Matrices 47 (PM 47; Raven, J.C., 1938): for logical-deductive reasoning abilities;
- Phonological Verbal Fluence and Semantic Verbal Fluency (Benton, 1994): for language and executive functions.

In addition, the following test can be administered to all subjects:

- Wisconsin Card Sorting Test (WCST, Heaton, 1981): for the evaluation of the ability to elaborate abstract categories and the ability to change the category according to a modification of the contingent situation.
- Colour-word test or Stroop test (Stroop, 1935): used to evaluate the difficulty in suppressing an automatic response.

4.1.2 Quality of Life and Psychopathological assessment for MCI

The quality of life (QoL) in older adults includes four domains of importance: behavioural competence, the objective environment, psychological well-being, and perceived QoL. Each of these domains is highly relevant to the assessment of QoL in older adults with cognitive impairment. For this reason, for the assessment of quality of life in older adults with Mild Cognitive Impairment we will use the Quality of Life–Alzheimer's Disease (QoL-AD) Scale (Logdson R. et al.; 2002). QoL-AD is a 13-item questionnaire designed to provide both a patient report and a caregiver report of the patient's QOL. To facilitate its use with cognitively impaired individuals, the QoL-AD uses simple and straightforward language, responses are structured in a four-choice format that is consistent across all questions, and all items are rated according to the patient's current QoL.

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Psychopathological symptoms will be investigated through the interview with the patient, the caregiver and through clinical observation with the Neuropsychiatric Inventory (NPI; Cummings, 1994). This will permit us to evaluate the frequency and severity of impairment of different behavioural domains of the MCI such as: delusions, hallucinations, aggressiveness, anxiety, aberrant motor behaviour, sleep and feeding disorders, depression, apathy, irritability, euphoria and disinhibition and assess the degree of psychological discomfort of the caregiver in relation to each area. Finally, for the assessment of functional autonomy we will use the Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (iADL), which respectively evaluate the integrity of the basic and instrumental functions of daily life.

4.1.3 Technological Literacy

In this part we will mainly use questionnaires to derive the level of technological literacy of the MCI older adults. The main objective of this activity will be to identify MCI elderly sufficiently familiar with technology, so that they can autonomously use the Rule Editor tool to create personalisation rules aimed to better support their daily activities. In D1.1.b we already identified a number of key questions to assess this aspect (covering aspects such as the types of technological devices they typically used in their life, or those they use for communicating with others): we will start from this set of questions to derive the level of familiarity of users with the technology.

4.2 Caregiver Assessment

We plan to use the Zarit Burden Interview (ZBI) – revised version (Hérbert, Bravo, and Préville; 2000) to measure the degree of burden in secondary end-users. It will be applied before and after the trials. ZBI is a 22-item self-report inventory which has been translated and validated in 18 languages all over the world. The questions cover the parts most frequently mentioned by caregivers as problems, including caregiver's health, psychological well-being, finances, social life and the relationship between the caregiver and the impaired person. Response options range from 0 (Never) to 4 (Nearly Always).

The assessment of formal and informal caregivers aims to evaluate possible changes in their quality of life and well-being after the PETAL-system use. As a matter of fact, caregivers may present a

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psychological burden due to the responsibility and the effort by assisting the elderly in their daily activities. Examples of statements used are "Do you feel that because of the time you spend with your relative that you don't have enough time for yourself?" or "Do you feel that your social life has suffered because you are caring for your relative?" etc. The caregiver indicated how much discomfort this concern caused by choosing the most appropriate phrase from "not at all" to "extremely." It is assumed that discomfort caused by these situations places burden upon the caregiver.

4.3 Personal Interviews with Caregivers and Elderly Persons

The results of the various tests and standardized questionnaires will also be integrated with a personal interview with the caregivers and elderly people who participate in the field tests to get a more complete picture of the life situation of the people involved. The questions that will be asked will focus on the "typical days" of the elderly, on the activities they prefer to carry out and on those they least love, on expectations for the project and on the greatest needs. In addition to this, important information on the biography of older people (most important steps: health state, family situation, ...) and any information on events that have affected people's lives will be collected. The caregivers - supported by the reference person of the research team - are encouraged to keep a kind of diary in which all important events that could have negative effects on the well-being, performance or health of the elderly person are reported.

4.4 Platform Deployment

In this phase the actual platform deployment will be done in the house of the participants to the field trials. This phase will be mainly done by the technician (identified in the Preparation phase described above), who will handle all the technical aspects associated with the installation and configuration of the PETAL platform in the house (e.g. setting/configuring Internet Wi-Fi, Bluetooth connections, tablet, sensors, light system), while relying on the help and support of the PETAL technical partners (CNR and Ideable).

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5. TRAINING MODULES AND CONTENT

5.1 Rule Editor Training for MCI and Caregivers

On the one hand, our platform will allow MCIs to create their personal rules according to their habits and their needs in the daily living activities. On the other hand, it will enable formal and informal caregivers to personalize specific rules in order to best fit their preferences and the needs of the elderly who they care for. As indicated in the project description, the user-centered platform provides personalized control of lights and digital appliances, personalized warning messages issued in potential risky situations, persuasive messages to stimulate the elderly in healthier habits (e.g., do more physical activity). To support a better understanding of the opportunities that our project offers to caregivers for monitoring and helping the elderly also remotely, we plan to organize a specific training before the use of the PETAL system. Hence, MCI patients and their caregivers will be asked to participate in a training session for at least one-hour organized by each of the four partners that will handle the field trial test (FSL, ANA, Apollis, Bartenbach) to familiarise with the tool that they are supposed to use during the trials, i.e. the Rule Editor. In particular, the training session covering the use of the Rule Editor will be structured according to the following steps. First, each training session will start with a PowerPoint presentation about the Rule Editor and its contained hierarchies of triggers and actions, and next a video tutorial will also show examples of specifying rules through the Rule Editor. Then, the MCI patients and their caregivers will write some rules in natural language, where at least one consists of two triggers and one action, in order to focus on rules of varying complexity. After this, they will try to specify the identified rules under the supervision and help of the psychologist who will help them only for building the initial rules, as from that point onward they are expected to proceed alone and use the Rule Editor autonomously in their everyday life (even though they will have constantly technical support for any inconvenience). At the end of this training, each subject will receive a user manual for the Rule Editor in order to improve their autonomy during the field trial test.

5.2 Cognitive Stimulation Tool Training for MCI Elderly

While training caregivers implies the use of rule editor platform, cognitive stimulation tool for MCI consists of a multi-device cognitive stimulation platform. Thus, for the elderly we plan to organize a

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training session where they could not only familiarize with the platform but also with the technological device, a tablet. A psychologist and a technician will help the elderly to power-on the tablet, insert their personal data and use the start menu, recognize the icons necessary to start the application and learning how to manage lighting system and sensors.

The aim of a cognitive work-out is to train different mental capacities, i.e. language, calculating, memory, attention, executive functions, orientation. The exercises are drag & drop, multiple choice, quiz, memory games, paintings. In addition, the device will present alerts received from the platform for the end user to promote wellbeing, to play serious games, etc. The platform will also collect information about self-assessment, emotional status and daily activity in order to embrace all aspects of elderly wellbeing. This meeting will last for an hour and the elderly will receive the booklet with the instructions to use that in their daily life. In conjunction with the training for elderly, the technicians will install the devices in their home.

6. RUNNING THE FIELD TRIAL TEST

6.1 Supporting Caregivers

As it has been already mentioned before, for each trial (MCI patient and associated caregiver) a dedicated team will be made available during the entire cycle of the field trial test (a computer technician, a psychologist/equivalent medical doctor, and a contact person). While the technician will be mainly involved in configuring and deploying the PETAL platform in the houses, in this phase, mainly the psychologist/doctor will be in charge of supporting the MCI patients and their caregivers with special attention to their needs and difficulties, and also the contact person will supervise the entire cycle and will be in contact with the end-users for all possible questions and requirements that may rise up during Petal platform use.

6.2 Online Routine Control Check and Diary

In order to better understand PETAL performance and end-users progress in the use of the devices, the “Routine control check list and diary” was developed by Apollis with partners’ contribution already for the first round of the field trials, and next translated in German, Italian and Romanian language. Thus, we will distribute it at each location where the field trials will be carried out in this

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second round. The first part of that document (whose detailed description was provided in D4.4a), consists in a routine control check list, in order to maximize the use of the devices in the correct way, with particular accent on what to control (if the tablet is charged, if the elderly wears the watch and it is charged, if the lighting system works), while a following part of that same document contains boxes for each day of the week in which caregivers could report on important events that could have a negative impact on the well-being, performance or health of the elderly person. Since in the first round of the field trials caregivers had some difficulties in maintaining this document always up-to-date, for this second trial, we decided setting up an online version of it, to facilitate reporting.

The caregivers - supported by the reference person of the research team – will be encouraged to keep this diary in which all important events that could have negative effects on the well-being, performance or health of the elderly person are reported. At the end of the test, any important events that have occurred during the test will be gathered. The objective of collecting this information is to help interpreting the final results, which may also vary depending on events that occurred during the course of the tests.

7. POST-TEST USER CHARACTERISATION AND DATA ANALYSIS

We plan to conduct a survey with the trial participants whose purpose is to evaluate the overall effectiveness of the PETAL system in the second cycle of the field trial. A similar survey was also used after the first round of trials. The questionnaire used contains 13 statements regarding either the single components (6 items) or the whole system (6 items), the last statement refers to the willingness of recommending PETAL to other elderly users. Caregivers will be asked to express their level of agreement in a scale from 1 “strongly disagree” to 5 “strongly agree”. For each item, there is the possibility to better explain the reason why they give that answer. In this way we have two types of data: 1) qualitative information from the open answers and 2) quantitative data from the closed answers. Following recommendations of the reviewers given at the meeting in Rome we will add some further questions on subjective utility, appreciation and satisfaction.

We also plan to exploit the monitoring features provided by the PETAL platform. They will provide data detected by the sensors deployed in the older adults’ homes, and also information about the personalization rules created, and when such rules have actually been executed.

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During the neuropsychological evaluation we will collect information about cognitive, neuropsychiatric, socio-demographic and quality of life of the elderly and their caregiver. Then, descriptive analysis will be used for end users and caregivers' characterizations. Compared analysis will be performed according to the neuropsychological, psychopathological and quality of life data collected before and after the field trial. Further, the results obtained between the first round and the second round of trial for the end users who participate in both rounds will be compared to identify any possible improvement in the measured variables.

Considering the limited number of cases addressed in the trials, the analyses will not only use statistical tools but will look at each trial as a sort of case study. For this purpose, the pre- and post-trial results have to be interpreted in terms of all the information collected by the other instruments previously described, like diaries and qualitative interviews and monitoring features.

CONCLUSIONS

In this document we report the activities we plan to carry out for the second round of the PETAL field trials. After installing the platform in older adults' flat, dedicated training will involve both kind of users to enable them to familiarise with the features of the platform.

The trials will provide useful information about the use of the platform in the wild: daily use in older adults' homes to investigate on its actual possibilities and the possible effects on the elderly with MCI and their caregivers. We will also collect various types of data before, during and after the trials to analyse more in depth the use of the platform and its actual effects.

Overall, the use of the PETAL system in 'real life' settings will allow us to get unique, and therefore invaluable, perspective on the day –to– day usage of our solution, which can be useful to better understand its potential commercial exploitation.

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