Specifications after 6 months

	Description of requirements after Phase I *(see also Evaluation Matrix for important factors to mention and how your description will be evaluated)*	Description of how the different aspects are addressed in detail after 6 months (Phase I) as preparation of the on the spot evaluation in Barcelona (July 2016)
General requirements		
Overall system	Specification of overall system setup with geometric parameters, weight of the system, description of interaction modalities. One single prototype mainly with mock-up functionalities, see below.	The ASSESSTRONIC consortium designed a modular solution consisting on 3 different levels of complexity both in terms of hardware and software. This solution maximizes the possibility of tests parallelization while limiting the costs for the hospitals. The idea is to allow the use of the technology that is strictly necessary for each test and avoiding unnecessary complexity (and consequently costs). The solution proposed is structured on 3 levels that are detailed here below in increasing order of complexity. ● The deskless module. It is the basic module of the solution. It requires only a device (a PC, a tablet PC or a smartphone) connected to the web. It consists on a software that can run automatically questionnaires-based and physical-based tests, in a 'light version'. For tests such as the Barthel and the MMSE, it provides interfaces that the user can use to fill the test. The user can be the patient, a relative (for instance, the Barthel test is usually completed by one relative too) or a health-professional that asks the questions to the patient and fills the test via the device. The software collects the answers, computes the scores and provides a dashboard for the display of the results in a time frame. Such a way of performing the mental tests is here indicated as 'light version', meaning that only the answers are considered for the score computation. The 'light version' of physical tests such as the Get-up & Go test consists on a software that the health-professional can use to record the video of the patient performing the test, to indicate the start and the end of the test via a timer and to manually enter some parameters such as the number of steps. ● The workstation module. It consists on a tablet PC/PC positioned

		on a table (for instance in the doctor's office, where the patient is asked to complete the Barthel test) or on a medical cart for more portability. This module can be used for all the questionnaires-based tests and for and physical-based tests, the latter in a 'light version'. During the questionnaires, some multimodal signals such as gestures, body language, gaze, emotions, facial expressions and voice will be collected and processed for further analysis. ● The mobile robot module. It consists on the medical cart energized by an autonomous mobile robot that ensures the autonomous displacement of the cart. Additionally, the cart embeds some sensors used for the human detection and to help the health professional setting up the physical-tests. In particular the cart embeds a Microsoft Kinect, a cheap and non-invasive sensor that allows the detection of the human kinematics and 2 laser pointers to spot on the floor the start and the end points of the test. This third level configuration allows the achievement of all the tests of the CGA process. In fact, beyond the functions possible with the second level configuration, it is suitable for physical-based tests because the robot is able to follow, track and analyze the patient's movements.
Weight	Describe all specifications concerning the weight of the solution. The specified system must be portable by a normal human, the first prototype can be bigger/ heavier, but needs to give an impression of the final one at the end of stage III.	The deskless module weight: it depends on the chosen tablet PC. The workstation module weight: it depends on the chosen tablet PC/PC. The mobile robot module weight: 12 kg.
Mobility	Mobility is closely connected with the afore described weight criteria of the system and addresses the platform's ability in terms of person following, face tracking, and similar advanced features.	The deskless module is a tablet PC, so there are not issues of portability. The workstation module can be embedded on the wheeled medical cart so it can be dragged with minimal effort. The mobile robot can be dragged with minimal effort as well (only 12 kg) or can be controlled via a web interface (max speed: 0.8m/s, max acceleration: 0.5 m /s^2).
Power supply	The specified system must be able to be operated both in battery mode for at least 8 hours, as well as in plugged-in mode, the first prototype can be powered by cable. For the final systems, inability to operate in battery mode may be a critical problem because the device will be used in	The mobile robot can operate both in plugged-in and in battery mode. The robot battery lasts 4 hours in continuous use (no stop movements). This time increases for a normal manipulation depending on the intensity of usage.

	patient's rooms or small places where plugging may be very complicated	
Language interface	Technical concept and prototype of a robust natural language interface which allows for multi-language support. Prototypes in stage I and II can use any European language (preferably English, Spanish, or Catalan), but the capability for multi-language support has to be demonstrated.	Our solution includes two main language-related interaction functionalities: ● A voice synthesis module that serves, e.g., to guide patients through the accomplishment of the different tests via audio channel. For Bathel and MMSE tests, this guidance is embodied in a conversational agent, dressed in clinician's clothes, with lip synchronization capabilities. Previous works have demonstrated the great benefits of using talking virtual agents as companions to interact with elderly people[1]. Moreover, lip synchronization will help a target population with frequent hearing impairments to better understand the tests questions (i.e. "lip reading" will be possible). ● A voice detection module that allows detecting natural verbal answers (based on key-words detection) and interaction commands from the patients. Both modules are based on the Microsoft Speech Platform (MSP), and are therefore multilingual. Voice synthesis and voice detection verbal contents are introduced in the platform in text mode (in a previous "edition" stage), and further automatically read/detected in the chosen language. For the stage 1 prototype we have made use of Spanish and French languages to demonstrate multilingual capabilities of our proposed solution.
GUI design Touch-screen interaction	Mock-up of touch-screen based interaction for all sorts of dialogues, for tests, configuration, and evaluation/data management. Other, yet easy to use and robust interaction modalities besides spoken language are also possible for the tests. They need to be able to be used if the natural language interface is not suitable, e.g. when a patient is not or only hardly able to speak. Also here, the multi-language issues	Our touch-screen interaction GUI design has followed a user centric approach, taking into account the two main actors: patients (i.e. elderly persons) and clinicians. After this first stage of the project, we have built complete and detailed mock-ups of every test dialogue, configuration dialogue and data management dialogue (they will be presented in Barcelona, on the 7th of July 2016). Our mock-ups are the result of a

[1] Wrobel, J., Pino, M., Wargnier, P., & Rigaud, A. S. (2014) "Robots and virtual agents to assist older adults: A review of present day trends in gerontechnology". J. NPG Neurologie-Psychiatrie-Gériatrie, 14(82), 184-193.

	apply in the same form as described above.	thorough iterative design process, carefully supervised and validated: ● from a psychological point of view, by psychologists and psychiatrists from the Pitié-Salpétrière Hospital (Paris) specialized in troubles of aging. ● from a geriatric point of view, by the team of geriatricians and neuropsychologists lead by Dr. Thierry Dantoine at the CHU Hospital of Limoges. Moreover, the usability and performance of the touch-screen and voice-based interaction design have been demonstrated in UX testing sessions with final patients at the CHU Hospital of Limoges (more details about testing are provided in Appendix 6). As explained in the "language interface" section, our GUI includes multilingual voice synthesis and recognition capabilities. All our touch-screen (text) dialogues are also configurable in multiple languages. Besides language and touch, our solution is also able to analyze in background (i.e. in a transparent manner for the user) other non-verbal relevant information, such as gaze behavior and facial expressions. This allows, e.g., to automatically detect the percent of time where the user focus of attention was in the test or elsewhere (quantitative measure of concentration/engagement), situations of stress, pain, depression, or the number hesitations while answering questions.
Motion tracking	Concept and exact specification of motion tracking system with planned analyses in context of the Get up and Go test and the Tinetti Balance and Gait tests	The robot is placed in the place where the health professional wants to carry out the physical test. The environment doesn't need to be previously known by the robot and doesn't need a particular configuration. The minimum uncluttered space required is 2m by 5m. The robot is equipped with 2 laser pointers that spot on the floor the start and the end points of the test (3 meters far away from each other). This makes the setup process very easy and fast for the health professionals because they have just to place the chair on one of the spotted point (start) and indicate the other point (end) with a mark on the floor (for instance with some adhesive tape). After this fast set up the test can start.

		The robot collects the user's movement information by using the embedded Microsoft Kinect sensor. The 3-dimensional position of 25 body joints are extracted and used as input for the analysis algorithm. Raw and processed data is recorded during the test in order to allow further analysis and to verify the results given by the algorithm in any moment. The analysis algorithms depend on the test. For the Get Up & Go test, first of all of all the algorithm analyse the collected data in order to identify the different phases of the test. We have defined the 5 phases shown in the figure below: ● Phase 1 (P1): getting up from the chair ● Phase 2 (P2): standing before walking ● Phase 3 (P3): walking forward ● Phase 4 (P4): walking back ● Phase 5 (P5): sitting back on the chair All the phases are analysed separately and the overall performance is scored with a scale from 1 to 5 meaning: 1. Well-coordinated movements, without walking aid -> No fall risk 2. Controlled but adjusted movements -> Low fall risk 3. Uncoordinated movements -> Some fall risk 4. Supervision necessary -> High fall risk 5. Physical support of stand by physical support necessary -> Very high fall risk Different factors are considered for the final score computation. First of all, the time (in relation to the patient's age) is considered relevant and discriminant. Other objective factors to take into account are the spatio-temporal parameters, which are considered to be relevant[2]: ● Step length ● Number of steps ● Step frequency

[2] Wolfson, Leslie, et al. "Gait assessment in the elderly: a gait abnormality rating scale and its relation to falls." *Journal of Gerontology* 45.1 (1990): M12-M19.

		● Velocity gait ● Arm swing amplitude ● Upper-lower body synchrony Besides the observed patient's motion behavior, the performance has to be analysed by taking into account other sensorimotor and psychological factors. For instance, the patient's visual condition (acuity, contrast sensitivity and depth perception) as well as mood, pain, anxiety and depression have been proved to have a significant impact on the standing movement performance. Knowing these patient's details, the overall assessment of his mobility condition is more accurate. A similar approach will be used for the Tinetti test. The Kinect data will be used to analyse the patient's balance sitting, standing and turning 360° and the performance during the gait (steps symmetry, continuity, length and height, trunk synchrony and so on). Such approach remains valid for other Gait tests. Some modifications can be discussed with the health professional if required.
Evaluation and data management		
Patient-specific view	Mock-up of the dashboard for one patient's data including his development in test results, and access to raw data, such as answers given in a specific test or videos and other visualization of the motion analysis.	A clinical data management system including patients' personal information, tests results, raw data and health history is developed. This dashboard has been designed in collaboration with the geriatric team of the Limoges CHU in order to define and understand the end-users needs based on a strong experience in assessing and following elderly. It is composed on a set of menus that allow the user to select a specific patient, access to his personal and health data (raw and processed). Filter research criteria are also available to make information easy to access. Through this dashboard the medical staff can also set the tests parameters for a specific patient, change the tests score results, add new patients and so on.

Analysis of results	Concept to interpret and codify patients/ relatives answers of selected tests and to calculate test scores based on codified information. The Health Professional has to be able to modify or correct tests scores	Some scoring criteria are proposed and are adjustable depending on the health professionals' needs and preferences. The tests final scores are editable as well. Different options for the scores display have been also discussed with some health professionals. The results of these preliminary study is presented to the client in Barcelona and the feedback will be take into account for the development of the final system.
Integration into clinical data management	Outline of the possibility to interface with clinical data systems in the overall concept.	Firstly we proposed to interface our system with the clinical data management software (gowinHIS) currently used in the hospital by API. However, the gowinHIS software is quite 'close' and none API is available. With the medical staff we discussed an easy solution to establish the communication. It consists on using specific IN/OUT folders and XML files to interchange the information between our system and gowinHIS. Each test will refer to an xml file to record and read the relevant information such as patient data, type of test and score. More sophisticated level may be implemented in the following phases. This will depend on the potential opening of the gowinHIS developers to communicate with external software.
Data protection	Description of data protection concept and fulfilment of standards.	Our system follows the standard for data protection, privacy and patient rights. The CGA platform meets the HIPAA (US) et EC requirements including the French laws for Hosting Health Data (Décrêt Hébergement Données de Santé). The CGA platform leverages existing Data Management solutions already meeting such requirements.
Configuration		
Patient- specific configuration	Description of mock-up of system dialogues for selection of tests and definition of test sequences in form of flow charts, handling of patient data.	The CGA platform propose a mock-up interface that allows the caregivers to: ● Chose the tests sequence for a specific patient ● Include in an individual CGA additional tests that are not in the predefined set ● Skip some tests if they are not relevant for a specific patient ● Change the order of the tests to run

Integration of new/additional tests	Description of mock-up of possibilities to develop a new questionnaire-type tests.	The CGA platform will provide the caregivers with an administrative interface to add new questionnaires in the system. The professional will have just to use this interface as tool to define a set of questions that have to compose the test and the system will automatically add the new questionnaire in the list of available tests. Also the scoring method will be customizable. This interface has not be programmed during the Phase 1, but an analysis of possible solution has been carried out. At the moment, the best solution for this function is to use an intuitive graphical interface, which allow the health professionals to add questions and to define the appropriate scoring criteria.
Calibration	Mention, if there is a need to calibrate the motion detection component and if yes, describe the necessary steps.	There is no need to calibrate the system for the motion analysis. Also, there is no need of calibration for other functionalities, such as voice detection or non-verbal behavior analysis.
On-site testing		
BARTHEL and MMSE Test BARTHEL: 2 tests à 15 min MMSE: 2 tests à 15 min	The proposed solution will be evaluated during the BARTHEL/ MMSE test based on its ability to interact with humans by speaking and natural language processing (even in case of slightly slurred speech) to limited extend, interpreting a set of standard pre-defined answers with multi-language support. An alternative mode of interaction like a touch screen tool may be considered to solve speech recognition issues. Describe possible explanations or Human-Robot Interactions here.	During on-site testing, we will present to evaluators our two mock-ups: the one for Barthel test and the one for MMSE test. Both patient side and clinician side (data management and configuration) interfaces will be shown. Barthel test will be demonstrated in our “deskless module” (handled tablet PC) and MMSE test will be performed in our “workstation module” (PC positioned on a table). Both tests will include touch interaction, virtual agent-based natural communication, voice synthesis and voice recognition capabilities (at an early stage of development, with pre-defined answers for demo purposes). We will also demonstrate our non-verbal analysis algorithms’ performance. Especial attention will be paid to explain to evaluators the evolution followed by our GUI, after the different phases of the iterative design process where psychologists, psychiatrists, geriatricians and neuropsychologists were involved.

		The interface language for the on-site demo will be Spanish, but we will demonstrate the multilingual capabilities of the proposed solution. We will also briefly introduce further steps that would be followed if our project is accepted in phases 2-3.
Get up and Go Test 3 tests à 20 min	The Get up and Go Test will be evaluated based on the proposed solution's ability to evaluate and record the patients' performance using standard components for motion analysis to the extent possible, to maintain sufficient visibility for the video and audio recording of patients during the tests and the platform's potential in terms of person following, face tracking, and other advanced features that will be implemented in the subsequent phases. Describe possible explanations or Human-Robot Interactions here.	The Get Up & Go test setting and the analysis algorithm are described in the section 'General requirements' of this document. The user performance is recorded (both raw data and results). Regarding the interaction between the patient and the machine, no physical interaction will take place (the user is not supposed to touch the robot). However, the robot will track physically the user in the sense that it will follow the user's movements (remaining at a certain distance) during the test. This is necessary for a good observability of the moving patient ensuring that he stays always in the field of view of the robot sensors. That is the main reason to use a mobile platform to carry out the physical tests.
Ethics	Please note that there are also ethical requirements to be described in a separate deliverable report.	
Economic Viability	Please note that you also need to include considerations concerning economic viability in a separate deliverable report.	