Specifications after 1 month

	Description of requirements after Phase I	Description of implementation plan for Phase I (to be delivered after 1 month – by January 31, 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.	During the Phase 1 the consortium will: 1. Define the best role that the technology can have in the CGA process. Different approaches and uses that a robotic platform could have to help during the CGA will be discussed with final users (expert doctors/nurses, patients and patients' families). For instance, the system could be intended to be used in care centers only, at patients' home only or both. This kind of information needs to be carefully considered during the design of the platform because it has an impact on the mechanical characteristics of the platform, on the maximal acceptable cost, on the portability and so on. If the robot is intended to be used at patients' home for example, a mobile platform is a questionable choice because of the poor portability, the set-up time required, the safety issues and so on. On the contrary, if it is conceived for care centers use, having a mobile platform that can move or be moved around the rooms, is obviously helpful. If the robot is intended to be used in both environments, a modular platform could be the best choice. The analysis of the feedback from the end users will lead to the design of a bespoke prototype. Note that the idea of having a system suitable for domestic use arose during the discussion with the geriatric unit of CHU Limoges Hospital that underlined the importance of assessing elderly more frequently than is currently done, ideally at home, also for prevention. 2. Realize a first prototype to be used for the first functions implementation and testing (first demonstration at the end of the Phase I). The ASSESSTRONIC consortium will focus on the specifications and on the first prototyping of the part of the platform dedicated specifically to the interaction with the user (interfaces), to the observation for CGA tests (sensors) and to the data management system. In this document, we will refer to this system as 'CGA platform'. For the mobility of the platform we will rely on an existing and already validated mobile robot (e.g. Double, QB, VGo, Beam and PatBot among others). In this document, we will refer to this mobile robot as 'mobile robot'. The choice of this supportive mobile robot will be made after an attentive market research. Ideally, the CGA

		platform will be enough flexible to be integrable on different supports quite easily. In this document, we will refer to the final complete platform (CGA platform + mobile robot) as 'CGA robot'. 3. Define both the hardware specifications and the software architecture of the CGA robot. The first prototype of CGA platform will be an assembling of already existing technological components and will have the only role of first demonstrator of the functionalities that will be developed during the Phase I and improved during the Phase II of the project. It will integrate in a consistent way all the hardware needful for the functionalities that the CGA robot has to fulfill: sensors for humans tracking, cameras, screens and microphones for natural and robust interaction, sensors for multimodal signal gathering and so on. The CGA robot will be a finalized product ready for the market and perfectly integrated.
Weight	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.	During the Phase I the ASSESSTRONIC consortium will work on the specifications of the final CGA platform and on the choice of a suitable mobile robot, both taking into account the project requirements (i.e. system portability). The physical and technical characteristics of the final CGA robot, such as design, embedded hardware, size, weight and so on will be accurately provided. The fulfillment of all the system requirements would be verified.
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 patient's rooms or small places where plugging may be very complicated	The ability to operate on battery mode for a required duration (at least 8 hours) is considered as mandatory condition to meet while selecting the mobile robot. Besides, also the CGA platform will be conceived to work both in plugged-in and battery mode. The batteries size and weight will be considered during the design of the CGA platform specifications in order to ensure the respect of the portability of the system.
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.	The usability of a system depends mostly on the quality of interaction that the user can have with it. The CGA platform will be equipped of a multimodal interface for a natural and reliable interaction. The graphical interface provided by a touch screen support will be complemented with a module of speech recognition and synthesis. For the vocal interface we will

		rely on one of the existing technologies already on the market (e.g. Nuance, Siri, Dragon and so on). The choice of the software will be made by tacking into account its performances but also the possibility to integrate it in the CGA platform software architecture and its capability for multi-language support.
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 apply in the same form as described above.	During Phase I, the touch-screen-based interaction will be defined and designed. From a hardware perspective, a touch-screen interface will be selected and included in the CGA platform's prototype design. From a software point of view, the system's architecture will be defined to be scalable enough to support multi-lingual dialogues (and to easily add new languages in the future). From a User Experience perspective, we will follow an iterative design process where end-users (medical staff, patients and families) will be continuously in the loop. To achieve this goal, we plan to make use of mock-up and storyboards of the touch-screen dialogues, and refine and validate them throughout several iterations of focus groups, personal interviews and A/B testing sessions with end-users. In that line, we have started to collaborate with the geriatric unit of CHU Limoges Hospital and we already collected some feedbacks useful to start the design process. At the end of Phase I, we expect to have: 1. A touch-screen device integrated in the first prototype of the CGA platform. 2. A complete storyboard for touch-screen interaction validated by end-users, for Catalan and Spanish languages. 3. A high-level implementation of the touch-screen dialogues for demo purposes.
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 consortium already has strong experience and international publications on the field of human detection and activity analysis. In particular, Accel already developed and implemented on a mobile robot a multimodal human detector, a method for determining the individual's anatomical parameters and the algorithms to animate a dynamic virtual mannequin based on the measurement of a number of characteristic points obtained by the Kinect embedded in the robot. The implementation of these methods have been validated experimentally on different physical exercises during which the performances have been compared with the measures collected by using a force platform.

		At the end of Phase I we will present 1. Existing algorithms for human detection and localization 2. Existing algorithms for human tracking 3. Innovative algorithms for human activity analysis and relevant parameters quantification/qualification. Then, during the project, all these algorithms will be integrated into the CGA platform making the final system able to execute autonomously the standard functional tests such as Get up and Go, Tinetti Gait, Tinetti Balance. These tests and their results will be manageable through the physician interface designed for the CGA platform. The use of a robotic system will bring several and substantial benefits: save time to medical staff, quantify in a rigorous way different parameters related to the movement of the patient and keep an accurate track of the evolution of the physical status (improvement after therapies or deterioration caused by diseases). In order to select the relevant features to collect and analyze during the physical tests, some geriatrics will be involved in the design/validation loop. Regarding the validation of the implemented software, we planned to test it in laboratories conditions before and in real environments then. The final system will be the result of several loops (tests, adjustments and tests again) with the end-users.
Mobility		
Platform's ability in terms of person following, face tracking, and similar advanced features	Implementation of patient motion tracking functions on sensors used for activity analysis.	The CGA platform developed during the project will be able to extract fine behavioral parameters based on indices of non-verbal (i.e. facial expressions, gestures, gaze, posture, etc.) and paraverbal communication (i.e. volume, pitch of the voice, speech, intonation, rate, breathing, etc.). Accessing to this information requires a focus on the signal sources (to detect and track the sources of audio, video signals and kinesthetic signals) in order to improve the quality of the perception and to avoid occlusions. This will be achieved by controlling the CGA robot movements according to the user's position and activity. At the end of the Phase I, the consortium will demonstrate advanced algorithms to detect human body, faces, limbs etc. and to localize the signal sources of interest such as the voice. During the following Phases, these functionalities will be integrated into the CGA platform and tested in laboratory conditions first and with the end-users in real life environment then. Once the sources are localized the CGA robot will be controlled accordingly in order to maximize the observability and to optimize the quality of the perception. The mobile platform will be chosen taking into account its capability of communication with the CGA platform.

		The protocol of communication between the 2 components will be as open and generic as possible in order to ensure the flexibility of the CGA platform of being carried by several mobile robots available on the market.
Actual testing		
Dialogue (questionnaire)-based tests	Mock-up of the dialogue-based Barthel test.	During Phase I, we will focus on the implementation of Barthel test to demonstrate the added-value of our CGA platform for questionnaire-based testing. Therefore, focus-groups, interviews and A/B testing sessions with end-users (patients, families and caregivers) will mostly turn around Barthel. ISIR-UPMC has a broad previous experience carrying out this kind of UX testing. These preliminary studies are meant to define the most convenient way to use technologies to perform questionnaire-based tests for CGA. For instance, a test can be presented as traditional questionnaire or as an interactive game (e.g. gamification has been demonstrated to present benefits for dyslexia or Alzheimer early diagnosis). Accordingly, we will also first analyze the suitability of the different facial reading, gaze tracking and voice analysis qualitative/quantitative metrics that we are able to extract through the Barthel test use case. However, special attention will be paid to ensure that the system will be scalable enough to easily add other questionnaires in the future, making use of the same techniques (facial reading, gaze tracking, voice analysis, etc.) to extract meaningful added-valued behavioral metrics. ISIR-UPMC will bring to the project its previous know-how and existing software (algorithms) for pupil tracking and facial expressions analysis.
Tests based on motion analysis	Mock-up of the Get Up and Go test.	The automatic analysis of physical activity can be done in different fashions depending on both the kind of technologies that one wants to use and the type of analysis that is required. 4 different approaches have already been identified 1. Kinect-based approach to collect accurate data of body movements. This approach allows the possibility to do a very deep analysis of the body posture and of the joints kinematics and dynamics by using a very cheap sensor. The ASSESSTROINC consortium already has research

		experience in advanced Kinect-based methods for human activity analysis. 2. Video-based approach to collect data easy to replay and suitable for tele-assessment. This approach is cheap and flexible (different type of cameras can be used), but requires a good set-up in the environment (position and lightening) and the image-processing algorithms can be very time consuming. 3. Wearable sensors approach for a portable solution. These kinds of sensors are low cost and portable, but may require calibration and are often inaccurate (only macro motion analysis is suitable). ACCEL already integrated in their platform the communication with smart objects to collect data about patients (weight, blood pressure, number of steps and distance covered etc). 4. Smart-phone based approach for a pocket-portable solution. By using the inertial sensor embedded on a smart-phone carried in a pocket or a bag, the macro activity of the user (e.g. the number of steps done, the covered distance and so on) can be recorded. The choice of the more suitable approach to have in the project will be made during the Phase I according to discussions and work sessions with physician and experts in the field.
Audio/Video recording	Proof of concept of the ability to record patients while they are performing the selected tests. Video recording is especially important for gait or balance tests, and audio and video for mental tests. The system should provide suitable point and field of view for the tests.	The CGA platform will be able to store the data collected during the tests to allow the medical staff to access to the history of each patient and check the evolution of his/er health condition. This recording will be made in the respect of the privacy rules and in an efficient way in terms of volume: the processed data instead of the raw data will be saved when this is convenient in order to reduce the volume without losing relevant information.
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.	During Phase I, the consortium will design a dashboard (physician interface) for allowing the medical staff to: - Register useful data related to the patient if needed (personal information, contact details, health condition and so on) - Display the results for each run test - Display the recorded data (raw data, processed data, score chart and so on) This dashboard (in a mock-up version) will be presented and discussed during the first demonstration at the end of the Phase I. ACCEL already developed a platform with a dashboard to register and visualize patients' data. This existing interface will be ameliorated taking into account the project requirements.
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	The CGA platform will be able to store the objective scores obtained for each questionnaire-based test but also to automatically analyze the qualitative results, which means interpret in a consistent way all the signals collected from the embedded sensors. This analysis will be based both on the existing literature and on the guidelines specified by the medical staff. To this end, the consortium will work closely with the end-users (caregivers) to define the criteria to consider for an accurate interpretation of the tests results. For instance, from the first exchanges had with the geriatrics team of Limoges CHU, we understood that the possibility of detecting emotional disorders such as depression and apathy by analyzing facial expressions during standard tests is extremely interesting and important from a medical point of view. The development of these advanced functionalities will consist in a continuous loop of programming and test with end-users (from hospital that already collaborate with the consortium partners, in particular CHU in Limoges and Charles Foix Hospital in Paris) during the project in order to deliver for the tests at the end of Phase II and III an already reliable system. The objective scores and the qualitative interpreted results will be stored in order to keep track of the history of each patient. Different charts will be available in the dashboard in order to display the evolution of this history.

Integration into clinical data management	Possibility to interface with clinical data systems in the overall concept	The CGA platform will be able to interoperate with clinical data management system of the hospital. All communications will be based on the IHE standard. Typical integrations with Health Information Systems or Electronic Medical Records include patient data management (HL7 ADT for registration / update), HL7 ORM or SIU for scheduling and HL7 ORM for reporting. XDS communication capabilities will also be integrated in the final CGA platform. ACCEL is an expert in clinical data management and already developed a platform for this purpose. This platform will be completed according to the project specification and integrated in the CGA platform.
Data protection	Description of data protection concept and fulfilment of standards	Our system will follow the standard for data protection, privacy and patient rights. The CGA platform will meet the HIPAA (US) et EC requirements including the French laws for Hosting Health Data (Décrêt Hébergement Données de Santé). The CGA platform will leverage existing Data Management solutions already meeting such requirements.
Configuration		
Patient- specific configuration	Mock-up of system dialogues for selection of tests and definition of test sequences in form of flow charts6, handling of patient data	The CGA platform will propose predetermined CGA tests sequence but through a tailored interface the caregivers will be able to: - 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	Mock-up of a functionality 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.
Integration of new tests based on motion/video analysis	Description of concept. This type of new assessments need the help of system experts, but the specified system should have the possibility to add such things.	The administrative interface designed for the caregivers will allow adding also new tests for physical analysis. The professional will have to use this interface as tool to define a set of movements that the patient has to execute during the assessment. General features useful for the understanding of the patient's performances will be automatically

		provided by the CGA platform (e.g. number of steps, quantity of movement, balance and so on).
Calibration	Mention, if there is a need to calibrate the motion detection component	The need of calibration for activity analysis component will depend on the approach that will be chosen by the consortium in collaboration with the medical professionals.