Idea Resume

Solution name:	ASSESSTRONIC	**Coordinator:**	ACCEL

Solution Description	**Key Features and Functions**	**Feasibility Assessment**
The ASSESSTRONIC solution is designed to do autonomously or assist the caregivers during the CGA process to assess patients' functional, mental and physical conditions. It is a modular solution consisting on 3 different levels of complexity both in terms of hardware and software. This 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 of complexity: • The deskless module: it consists on a software that can run automatically questionnaires-based and physical-based tests, in a 'light version' • The workstation module: it consists on a tablet PC mounted on a support designed for telepresence applications. This module can be used for all the questionnaires-based tests and for and physical-based tests, the latter in a 'light version'. • The mobile robot module. This module consists on the medical cart energized by an autonomous mobile robot that ensures the autonomous displacement of the cart. This third level configuration allows the achievement of all the tests of the CGA process.	The principal key features that we tackled for all the 3 configurations are: • User Experience and social acceptance. The solution is not invasive for the patient: the patient's position and orientation during the tests cannot be constraint too much, he/she doesn't have to wear special equipment such special clothes, wristbands, etc. Design's usability and accessibility has been implemented and validated by a multidisciplinary team made of engineers, psychologists, psychiatrists, geriatricians and neuropsychologists. • Portability. The solution is manageable by a normal human to be moved around at the clinic. • Modularity and scalability. The solution is modular and scalable in order to facilitate an international deployment as potential extent. • Mobility. The mobile platform guarantees the constant visibility of the patient to increase the quality of the information (signal / noise ratio) gathered by the sensors, which would also simplify the signals processing and improve the algorithms performances. The fulfilled functions are: • Questionnaires-based tests. The solution is able to carry out autonomously or semi-autonomously (when the nature of the test compulsorily requires the presence of the health professional) the CGA questionnaire-based tests. • Physical-based tests. The solution is able to track the patients' movements and to evaluate their	In the initial phase of the project the ASSESSTRONIC team has brainstormed a variety of potential solutions in terms of technical feasibility, business viability and cost-effectiveness. First of all we discussed different solutions able to meet the requirements of the Echord++ project (i.e. parallelization of the tests, reduction of the health professional intervention during the CGA process, accurate and comprehensive track the patients' outcomes, objective and precise analysis of qualitative and quantitative parameters and so on). The engineers of the team made a first selection by taking into account the technological constraints and the technical feasibility. The second selection has been made by analysing the European economic model in public health with health professionals. It came to light that the solution is cost-effective if it doesn't exceed 8K€. This has been confirmed by the Dr. Gálvez Barron (the client) and Prof. Dantoine (CHU Limoges). In effect, such low cost is affordable for public health system and insurances and can represent a saving with respect to the medical staff costs (while compensating the lack of resources due to the high personnel costs). The modular solution described in the section Solution Description of this document is the result of this preliminary study.

performance during physical-based tests such as the Get Up & Go and the Tinetti tests. The parameters useful for evaluating the quality of the motion (i.e. speed, number of step, step length, frequency and so on) are collected, interpreted and stored.

- Health professionals with a dashboard to display raw and processed data, manually modify or correct tests scores, select the sequence of tests to include in an individual CGA, easy configure and new tests.
- Data Management. Both raw and processed data must be stored safely, in an open format (also other then text) and has to be readable from free non-proprietary software (e.g. XML or CSV).

Critical Uncertainties	**Economic Viability**	**Potential Impact**

The major uncertainty is the acceptance of the robotic platform by the patients. If there is no doubt that the medical personnel would accept the use of such a system because this entails a gain in term of time and accuracy for CGA, the patients could be annoyed for interacting with a machine. In fact, the current generation of elderly are not familiar with the technology and most of them are scared of using it, especially for medical reasons.

We discussed this issue with some geriatric doctors and we learnt that despite this lack of experience and confidence, the use of technology can have several advantages:

- Sometimes the patients feel discomfort in interacting with medical staff because they are afraid of their judgment. This kind of stress can affect the tests results. The interaction with a machine instead, is sensed as neutral and not judgmental, which has a positive impact on the exactness of the results.
- Some of the tests of the CGA process require the health professional to interpret the results

The economic implications of implementing and operating a machine for assisting during the CGA process has been discussed with health professionals from France and Spain in order to have an understanding of the economic viability of the solution. It came out that the economic sustainability is ensured with a solution that does not exceed 8K€. For the demonstration in July 2016 we present a prototype costing 7K€. This price will considerably decrease for larger production (a reasonable estimation of the final hardware costs is around 3K€). To this price we have to add the costs for software licences that we will buy if the ASSESSTRONIC project will continue in Phase II and III (for instance an effective voice recognition software). We can estimate that the final cost of a platform will not exceed 4K€.

The outcome of the project could have an impact on the geriatric community by offering a more efficient way of detecting and assessing fragile / dependent persons and partially address the dilemma of a growing ageing population with less medical resources and / or insufficient funding / staffing.

ASSESSTRONIC advances key robotics technologies by providing innovative interaction capabilities for social mobile robots. As results of integration of methods and algorithms beyond the current state of the art (but already known by the team), the project will deliver a product reliable and useful for the medical community because able to reduce the time to spend in standard assessment, to make the diagnosis more accurate and to manage the health data in a safe and friendly fashion.

The consortium will also publish quality journals about scientific achievements (robotic technology being used in geriatric care) beyond the state of the art. This will impact on both engineering and medical communities.

- Accel is the member within the consortium who will commercialize the results of this

because of the lack of precise parameters. In fact, the same test for the same patient can have different results if performed by 2 different health professionals. This lack of objectiveness can be compensated by using a machine, which takes into account always the same quantitative and qualitative parameters for scoring the tests.

- The use of sophisticated algorithms for the analysis of relevant signals such as the voice, the gaze and the facial expressions, can generate richer and finer information that it is not directly observable by a human being.
- The ability to track the patients' outcomes accurately and comprehensively is another key reason that motivates the use of the technology for CGA process. The information about the previous patient's status are particularly important to health professionals for devising a personalized care plan adequate to patient and relatives' profile.

program:

- Accel already equip many French institutions dedicated to dependent elderly people of 3 large French regions (Nord Pas de Calais, Aquitaine and Limousin).
- Accel created a medical board that include several key opinions leaders in France in the medical field of geriatric.

Challenges Phase I

The Phase I is supposed to be the design step. The big challenge is to draft a solution that is the better compromise between the medical requirements, the technological limitations, the user acceptance and the economic viability. This challenge has been tackled by a rigorous collaboration between some health professionals for a medical expertise and the ASSESSTRONIC consortium for the engineering skills and the Healthcare IT competences.

We went beyond the stage of design and we began the development of some functionalities. In particular we implemented some algorithms for gait and facial expressions analysis. The technical challenges are related to the nature of the research itself: we want to integrate on the robot functionalities that are

End-User Involvement

The most critical stakeholder in any product development is the end user. In fact, leaving the design to the developers may result in a technically elegant solution that is difficult and unappealing to use. Also, testing the system in laboratory conditions may not reflect the real performances of the solution when used by non-technical users in unconstrained environments. For this reason, the end-users (health professionals and patients) have been involved in all the steps of the product development.

First of all we discussed with Dr. Gálvez Barron the real needs and the most critical requirements that the solution needs to meet. We took into account his feedback to design a first solution. This first solution

Idea Sketch

The ASSESSTRONIC technical solution is designed to do autonomously or assist the caregivers making the patients to perform some functional, mental and physical tests and to evaluate patients' performance during walking tests (like gait and balance tests) in the particular context of CGA.

Who: the target users of robotics technology for CGA will be the Health Professionals, patients and their relatives during the CGA process.

What: the technological solution must serve the following needs:

- Make patients able to perform autonomously CGA process or with minimal intervention by the health professionals.
- Track the history of the patient status and store

innovative, but at the same time reliable and accurate. For instance, we have to face: difficulty of pupil detection for gaze direction analysis (especially when large distances exist between the user and the robot and when large head movements occur); bad lighting conditions and face positions problems for facial expression recognition; environmental noise for voice recognition; human body tracking and activity analysis problems in conditions of important occlusions; privacy issues for private medical data storage and management. However, the teams involved on the project have been selected because of their skills, experience and reputation in these fields. The composition of the consortium makes all the technical challenges totally manageable.

has been analysed again by Dr. Barron and by Prof. Danoine, which approved some aspects and gave suggestions for improving some features.

Barthel and MMSE tests interfaces were designed following a user-centered iterative process in close collaboration with psychologists and psychiatrists from Pitié-Salpétrière hospital (Paris). They helped us to define interaction guidelines for the most appropriate design of the GUIs from a psychological point of view. Then, the interfaces defined with the psychologist have been discussed with Prof. Dantoine in order to have a feedback from a geriatrician point of view. Eventually both Barthel and MMSE tests have been proposed to some patients of the CHU in Limoges in order to have a first feedback about usability.

We discussed step by step with Prof. Dantoine also the interfaces designed for health professionals to display the tests results, to customize the tests sequence and to create new tests.

We refer to the Appendix 6 document for more details about the end-users involvement in the solution development process.

raw and processed data/tests results.
- Increase the accuracy and the objectiveness of the tests results.

Why: most geriatric assessments, performed under the constraints of time and money, tend to be less comprehensive and more directed. An automation of the process achieved by using a technology solution is highly suitable for absorbing the demand without compromising on the quality of the assessment and containing the costs.

Where: the solution must be usable in Hospitalization Units for inpatients, Day Care Hospital or Ambulatory Care Units for outpatients.

When: the CGA should be performed at least twice a year in order to allow a correct following of the patients. By using a technological solution, which reduces the intervention of the health professional during the CGA process, the patients can benefit of even more frequent assessments while requiring an acceptable use of resources with no additional costs.