

### 3 Publishable summary

Long Lasting Memories (LLM) is an EU project aiming at an integrated ICT platform which combines state-of-the-art cognitive exercises with physical activity in the framework of an advanced ambient assisted living environment, while respecting ethical and legal boundaries. By combining cognitive exercises and physical activity LLM delivers an effective countermeasure against age-related cognitive decline, thus actively improving the quality of life of the elderly and significantly prolonging the time they can remain independent at home.

The LLM service can be installed in individual homes, day care centres, or formal medical settings, enabling personalized and monitored physical and cognitive training of its users. Meanwhile, users are able to take advantage of features of an independent living solution. This is accomplished by home automations that compensate for the mobility or communication limitations of elderly people during their daily activities. An elaborated distributed sensor network guarantees immediate response in case of an emergency, by calling for help through public telephone lines (in case of home installations), or issuing alerts to onsite caregivers (in case of other installations).



Figure 1: LLM service

The LLM service is designed to comprise of three existing interoperable components which perform complementary and interactive tasks to provide the system's services:

- The **Independent Living Component (ILC)** is based on the eHome system, which is a network of distributed, wirelessly-operating sensors connected to an embedded system (the e-Home central unit). It includes features such as intelligent learning of normal and exceptional patterns of behaviour (dangerous situations or indicators for emerging health problems), and relevant alarms. eHome is a project funded by the Austrian Research Promotion Agency (FFG).

- The **Cognitive Training Component (CTC)** is designed to support cognitive exercises provided by specialised software. A variety of software can be used for this process; having started from an initially proposed list, a careful selection and evaluation has been performed by the LLM partnership so as to identify the appropriate software for testing during the project and for completing customization and localization of this software as needed for the initial deployment and the pilot testing of the LLM system. Currently taken choices include the BrainFitness Software by PositScience and the GRADIOR software by Intrax (LLM partner No.7).
- The **Physical Training Component (PTC)** consists of custom training equipment, geared to meet the specialised needs of the elderly. PTC provides exercise performance output to the central LLM system for further monitoring and processing. Having started from an initially proposed list of using (expensive, dedicated) treadmills and/or bikes, the LLM consortium has made a more contemporary choice based on the Wii remote and Wii balance board platforms; the LLM consortium has therefore specified a modern, modular and inexpensive way of binding the PTC into the LLM system, thereby complementing the cognitive training protocol with a physical training protocol in a scientifically sound way.

LLM runs from June 2009 to November 2011. As of end of April 2010 the project has achieved the following:

1. A review of the state of the art in ambient assisted living environments that make use of ICT platforms that combine (a) cognitive training exercises and (b) physical activity. Furthermore, a review of the state of the art in components that provide individually eHome services and physical training
2. The technical and operational specifications of the service were defined. Integration started with development of the web service, which is responsible for providing all methods and functions in order to support the three independent components' functions, and the database, which accompanies and supports the web service's procedures.
3. An LLM specific Web Service (the LLMWS) was developed, forming the main heart of the system. It is responsible for management of clients' levels of authorisation and also for providing all methods and functions in order to support the three independent components' functions. Moreover, the web service is responsible for the authentication of the system's users according to their role. A database accompanies and supports the web service's procedures. The web service's architecture and functionality will be open in order to allow new developments to be integrated and supported by the proposed service. Consequently, the main scope of the web service architecture is to provide a way to integrate future developed components (CTC, PTC, ILC). The only prerequisite for the candidate applications to be integrated into the proposed service is to be compatible with the general framework of the service.
4. Technical adjustments were performed and a prototype was developed. Specifically, an existing eHome prototype installation has been enhanced to incorporate the CTC (cognitive training component) and PTC (physical training component), following specific integration steps and hardware and software requirements. The LLM service was also validated against the set of general and specific criteria.

5. Developments on the PTC front had to allow for the integration of both the treadmill and bikes option (and their associated protocol and software). This, however, formed an expensive approach for the LLM service and therefore was put as a second priority, the first one being an inexpensive and more modern solution. To this end, FitForAll was developed, which is a game-like platform that is used for the fitness training of senior citizens, which introduces seniors into a semi-virtual environment and exergaming technology. In this way, a low-cost training platform is offered to end users to improve their physical status in a more engaging and entertaining way. It is a software package that provides a means of interactive training, via body movements and appropriate system feedback. FitForAll developments were given high priority so as to enable to full physical training protocol to be able to run in it.
6. Localisation of the three components (CTC, PTC, ILC) has also been undertaken in this period, so that the components are available in all trial partner national languages. Localisation of eHome and PTC differs considerably from the CTC one; the former two involve mostly a translation from one language into another, while the latter one involves a good amount of scientific and technical work associated with the phonetics and linguistics fields.
7. Deployment plans for pilot testing were specified to take place in 5 EU Member countries (Austria, France, Greece, Spain, and Cyprus) for a period of 15 months. At the end of the pilots, analysis of all results will be evaluated against: (i) the robustness of the Technology Solution, (ii) the achieved Usability; (iii) the impact on Health (physical and cognitive results); and (iv) the prospective Marketability of the service.
8. A detailed market survey in the fields of ICT solutions for the elderly was conducted. Though several such solutions have been introduced over the last years, existing systems are still lacking the wide market penetration they could achieve. Lack of familiarity with technology by potential end-users, cost, and insufficient robustness of features have all been considered as the main causes of market underachievement. Identification of all relevant factors and focusing on countermeasures to promote the LLM service in this newly arising market was the main target of this task.
9. Existing legislation, directives, and other notable published guidance on a European and international level were examined. For each of the countries where LLM will be piloted, a detailed description of the national regulations for conducting the pilot was produced.
10. A comparative review of legal and ethical issues in each pilot-holding country are currently being compared against the service's specifications in an effort to identify specific issues related to security, data protection and privacy management.
11. A workshop is organised to take place in Athens (May 2010) aiming at looking at the full range of issues related to the LLM service, from policy matters such as ethics, to technical and scientific concerns, to logistical and commercialization issues. The workshop will feature hands-on demonstrations of the Independent Living, Physical Training, and Cognitive Training Components of the LLM system, a detailed review of the scientific protocols and outcome measures, and a look-ahead at issues related to successful market introduction for the LLM service in Europe.

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In summary, the main results achieved over the first year of the project are:

1. State-of-the art review in current ICT platforms that combine (a) cognitive exercises and (b) physical activity
2. Definition of the technical and operational specifications of the LLM platform - Definition of stakeholders and user requirements of every pilot - Analysis of the different technical infrastructures and circumstances of each trial partner
3. Development of the LLM prototype system
4. Deployment plan for pilots
5. Detailed market investigation in the fields of ICT solutions for the elderly
6. National and European legislation on the clinical care trials and eCare systems
7. Technical specifications for user privacy reassurance
8. The first LLM workshop and a number of other dissemination activities took place.

The strategic impact of the LLM project lies on its ambition to proposing an innovative ICT solution towards the benefit of older people and especially those suffering from age-related cognitive decline. The initial feedback of this period showed a great interest of public authorities and private institutions that will be continuously pursued through extensive dissemination activities, as an effort to promote a business model based on public-private partnerships.

Current project progress shows that the LLM service has the capacity to improve the quality of life of older people and their families:

- by allowing older people to remain at their homes, which is their most convenient and frequent request
- by providing a safe and cosy environment for living with the eHome AAL solution
- by supporting them in remaining mentally, physically and socially active for a longer period of time through the cognitive training process
- by a monitoring system effectively addressing the fears and anxiety that seniors' relatives feel when they leave their parents alone.

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#### **Public website**

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