

	SEVENTH FRAMEWORK PROGRAMME Information and Communication Technologies
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\*Dissemination Level:

PU=Public

PP=Restricted to other program participants  
(including Commission Services)

RE=Restricted to a group specified by the consortium  
(including Commission Services).

CO=Confidential, only for members of the consortium  
(including Commission Services).

\*\*Nature of Deliverables:

R=Report

P=Prototype

D=Demonstrator

O=Other

## PROJECT PERIODIC REPORT

Grant Agreement number: 611650

Project acronym: DOREMI

Project title: Decrease of cognitive decline, malnutrition and sedentariness by elderly empowerment in lifestyle Management and social Inclusion

Funding Scheme: Programme acronym: FP7-ICT, Subprogramme area: ICT-2013.5.1, Collaborative project

Date of latest version of Annex I against which the assessment will be made: July 31<sup>st</sup>, 2014 (version 05)

Periodic report: 1st ☐ 2nd ☒ 3rd ☐ 4th ☐

Period covered: from 01.11.2014 to 31.10.2015

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### DECLARATION BY THE SCIENTIFIC REPRESENTATIVE OF THE PROJECT COORDINATOR

I, as scientific representative of the coordinator of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate)<sup>1</sup>:
  - ☐ has fully achieved its objectives and technical goals for the period;
  - ☒ has achieved most of its objectives and technical goals for the period with relatively minor deviations.
  - ☐ has failed to achieve critical objectives and/or is not at all on schedule.
- The public website, if applicable
  - ☒ is up to date
  - ☐ is not up to date
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 3.4) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 3.2.3 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator: Prof. Oberdan Parodi

Date: 30/ 10/ 2015



For most of the projects, the signature of this declaration could be done directly via the IT reporting tool through an adapted IT mechanism and in that case, no signed paper form needs to be sent

<sup>1</sup> If either of these boxes below is ticked, the report should reflect these and any remedial actions taken.

### List of Beneficiaries

No	Participant organisation name	Short name	Country	Project entry	Project exit
				month	month
1	Consiglio Nazionale Delle Ricerche	CNR	IT	1	36
2	Università di Pisa	UNIFI	IT	1	36
3	TSB Real Time Location Systems SL	MYSPIERA	ES	1	36
4	AIT Austrian Institute of Technology GmbH	AIT	AT	1	36
5	Fundació per a la Universitat Oberta de Catalunya	UOC	ES	1	36
6	The Extracare Charitable Trust	Extra	UK	1	36
7	Imaginary Srl	IMA	IT	1	36
8	De Montfort University	DMU	UK	1	36
9	Age Platform Europe AISBL	AGE	BE	1	36
10	SI4LIFE – Scienza e impresa insieme per migliorare la qualità della vita srl	SI4LIFE	IT	1	36
11	Accord Housing Association Ltd	Accord	UK	1	36

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## 1. PUBLISHABLE SUMMARY

### 1.1 Summary description of project context and objectives

The DOREMI Project context and Scientific and Technological objectives, for Period 1, were:

- Development of an unobtrusive monitoring environment keeping track of the daily activities of the elderly people at risk of malnutrition, sedentariness and cognitive decline according to the “active ageing lifestyle protocol”(MS1, M8) established by the specialist.
- Final Selection of the sensors (MS2, M9) according to parameters identified in the protocol.
- Preliminary data set collected from the selected sensors available for the data driven model (MS3, M12).

The Scientific and Technological objectives, for Period 2, have been:

- Development of a preliminary version of the WSN environment, of Smart environment for Context awareness and of gamified environment system (MS4, M18) with involvement of WP3, WP4 and WP5.
- Development of sensors prototypes ready for the validation activities, WSN environment and auto configuration system (MS5, M24) under WP3.
- Development of the social and gamified environment ready to be integrated in DOREMI system (MS7, M24) (WP5).

### 1.2 Work performed since the beginning of the project and the main results achieved so far

The work performed, in the first year project activities, was strategically directed to the achievement of the first three milestones of the project MS1 (M8), MS2 (M9) and MS3 (M12).

Considering the relevant dependency of the technical development work packages (WP3, WP4 and WP5) with the main scientific model and target user work package (WP2), the scientific and technical coordinators have agreed to follow a WP interaction approach based on an iterative instead of a sequential method.

The main result of this constructive interaction was the common definition and design, agreed by both clinical and technical partners, of the Active Ageing Lifestyle Protocol of the DOREMI project (WP2). The design of the DOREMI protocol and the selection of the main items from the various protocols taken from the literature, had taken in full consideration opportunities and constraints offered by the gamification environment and monitoring environment that will have to finally automate the process of monitoring and assessment of the target user daily improvements compared to the level of impairments registered at the baseline. Work in WP2 has foreseen three main phases:

1. Discussion and agreements on the main protocols to be selected and studied from the literature in the scientific areas of cognitive (main impairment), nutritional, physical activity, social interaction (from real life and virtual perspective). This work was reported in D2.1.
2. Planning and agreement on the DOREMI monitoring environment and the parameters, activities, behaviours and actions to be selected as main representative and useful to monitor the progress and improvements of the target subject. This work was reported in D2.2.
3. Organization and systematization of all the testes and procedures defined in D2.1 and D2.2 and the design of the entire validation process of DOREMI environment. This work was reported in a draft version of D2.3.

WP3 was focused on the development of WSN environment and the auto configuration system. These elements were developed gathering requirements in coordination with WP2 and WP4. In particular, in WP3 it was:

- selected most appropriate sensors and devices and started designing and development of sensors and devices foreseen in the project (bracelet) or integrated in commercial solutions (smart carpet).
- performed a data collection and retrieval layer necessary for data processing and interoperability with the smart environment.
- started the initial design and development of auto configuration system and the integration of sensors in WSN environment.

WP4 worked on the identification of computational learning tasks of Activity Recognition and its requirements investigating machine-learning solutions for both explorative and predictive data analysis.

In particular, WP4 has:

- contributed to the design of high-level DOREMI system architecture throughout a close integrated activity between clinical requirements and technical specifications.
- released a requirement analysis and a specification of the services implemented by the smart environment system, an analysis of the computational methodology adopted for the activity recognition and reasoning components.
- produced a summary of the guidelines for the collection of annotated training data in WP6.

Object of WP5 was the development of the overall gamified active ageing support environment for older users.

In particular, WP5 work was focused on:

- definition of gamified active ageing protocol
- collaboration with medical partners for identification of main structural elements of DOREMI protocol.
- design and development of the game-based environment.
- development of a preliminary set of cognitive games prototypes.

WP7 was focused in this first year to define the communication strategy of the project.

Main activities were:

- development of dissemination plan, with particular attention to the design and development of DOREMI website and portal useful for the on-line engagement of DOREMI stakeholders.
- development of exploitation plan focused on a market analysis to quantify the market segments of DOREMI solution.
- development of IPR strategy of the DOREMI consortium.

During the second year of project, the work was directed to the achievement of the three milestones of the project: MS4 (M18), MS5 (M24) and MS7 (M24).

The progress towards the achievement of these milestones passed through a devised and well-coordinated execution of tasks and sub-tasks under the relevant WPs, namely WP3, WP4 and WP5.



For period 2, WP2 activities were prolonged further on the planned closure (M12) with the main purpose of defining technical and methodological aspects of the Active Ageing Lifestyle Protocol: for this activity a continuous work of information exchange between medical and technical partners was required. The Active Ageing Lifestyle Protocol of the DOREMI project has reorganized and systematized all the tests and procedures described under WP2. For its fundamental role in DOREMI experimentation, Active Ageing Lifestyle Protocol required a deep work of analysis and resolution of three main points:

1. The choice of the most accurate test for measurement of Mild Cognitive Impairment (MCI).
2. The criteria and technical tools to be used to quantify Social Interaction through the DOREMI Gamified environment.
3. The design of the statistical evaluation process that will be applied on the collected data.

This work was described in D2.3; for reasons described above, the planned submission date (October 2014, M12), was delayed until March 2015 (M17).

WP3 was focused on the development of WSN environment and the auto configuration system. These elements were developed gathering requirements in coordination with WP2 and WP4. In particular, WP3 products were:

- DOREMI wristband: device which provides indoor location, step counter, full access to 3-axis accelerometer data and heart rate measurement. This device let to perform caloric consumption assessment, the activity recognition or the pattern detection.
- Smart carpet: a device for an easy and precise measurement of weight and balance.
- Environmental sensor network: a set of presence detector and door contact sensors installed to effectively assess the socialization aspects of the user when is at home.
- Indoor location network: a set of reception devices that enables precise indoor location and a communication infrastructure for the DOREMI wristband.
- DOREMI gateway: a central element to concentrate all the data coming from user's house and forwarding it to remote DOREMI servers.
- DOREMI middleware and integration layers: a software tool to connect all the data sources to a common communication platform and make available these data to all the DOREMI subsystems.
- Auto configuration system: an effective system to manage several DOREMI system working and the same time and a way to declare all the published data and make it accessible by other applications.

WP4 has worked on the identification of computational learning tasks of Activity Recognition and its requirements investigating machine-learning solutions for both explorative and predictive data analysis.

In particular, WP4 has:

- preprocessing, cleaning and segmentation of noisy streams of environmental and personal sensors within DOREMI middleware integration.
- exploratory data analysis to identify patterns of user habits from traces of indoor mobility.
- supervised short-term human activity recognition/estimation for estimation of parameters, such as calorimetric expenditures, balance skills and patterns of social indoor visits.
- aggregation and reasoning over activity recognition and games data across different time-scales to automatically assess compliance of the users with the DOREMI lifestyle protocol.

- visualization of the user parameters of interest for the DOREMI lifestyle protocol to the general practitioner through the Dashboard component.

Object of WP5 was the development of the overall gamified active ageing support environment for older users.

In particular, WP5 work was focused on:

- final development of the game-based environment.
- development of final version of cognitive games prototypes.
- development of final version of social games prototypes.
- development of final version of exergame prototype.

The focus of the WP6 is the validation of the DOREMI system both at lab and pilot site. The main activities, performed during the second year of project were based on:

- collection of data produced by smart carpet functionalities for evaluation of balance assessment and validation of Activity Recognition models.
- collection of data produced by DOREMI wristband for caloric consumption assessment and first validation of Activity Recognition models.
- validation and testing sessions of game prototypes and gamified environment.
- pilot site preparation, with recruitment and enrolment of participants.
- pilot site preparation, with discussion of technical details for installation of DOREMI system.
- integration of components developed by different partners under WP3-WP4-WP5 and the validation of the context-awareness system at Living Lab (Valencia).

WP7 was focused in this one and a half year to define the communication strategy of the project.

Main activities were:

- development of the competitive analysis of the alternative products to DOREMI and understanding of market positioning for its components and whole solution.
- refinement of tools for dissemination activities.
- participation to events for dissemination and exploitation activities.

### **1.3 The expected final results and their potential impact and use (including the socio-economic impact and the wider societal implications of the project so far)**

According to the prescription of the EIP AHA working group on the Action Plan A3: “Prevention and early diagnosis of frailty and functional decline, both physical and cognitive, in older people”, applying ICT and e-health to services is expected to be effective in the prevention and treatment of functional/cognitive decline, and to increase the independence and self-reliance of older people. This may result in better quality of life and a reduction in the use of health care services due to increased independent living.

DOREMI expected final result is a platform made of 3 modular building blocks. The modularity includes not only the possibility of a “combination” of all the three building blocks or only two of them (within the monitoring environment the building block n°2, will always have a pivotal and foundational role as explained in the appropriate paragraph), but also a possibility of combination and activation of

selected services within each building block, depending on the market segment addressed, the budget availability of the buyer, or the main functional or behavioral aspect that the customer wants to monitor and improve (e.g. giving more relevance to physical activity and socialization or physical activity and diet, or any other possible combination).

### DOREMI 'Building Blocks':

1. **Social and gamified environment:** Games whose primary purpose is not necessarily entertainment, but where the goal is to engage, train, motivate, educate users. Games are used to stimulate and encourage compliance with active ageing lifestyle 'protocols', which have been assigned by specialist. The motivational games for physical and social activity are associated to sensors (the monitoring environment) to track daily activities and collect relevant parameters for self-evaluation of lifestyle protocols and reports for specialist. The cognitive games are not associated to any sensor and the score level of the user measures the performance. The diet games are associated to a diet application reported in the monitoring environment (provided by the third party software producer METEDA, together with the DOREMI consortium now pursuing an exploitation alliance). All the games will run in specific tablet applications to increase the level of usability, user experience and interaction thanks to the touch screen.
2. **Monitoring Environment.** The monitoring environment is made up of environmental, wearable sensors, a diet app, a smart carpet aimed at collecting, in the less psychologically and physically intrusive manner in order to respect to the privacy and self-esteem of the subject monitored, either raw data and more elaborated information from a set of sensors (e.g. Internet of Things paradigm) or from applications running on the tablet (Internet of People paradigm), where the user is reminded to enter the data.
3. **Context-aware smart system.** The context aware smart system is made up by i) Human Activity Recognition (HAR) models needed to recognize and contextualize the user's daily activities monitored by the sensor and their relevance for the DOREMI protocols ii) a reasoning system that aggregates the output from the serious games and activity recognition components, and to predict the most appropriate lifestyle protocol given the specificity of the environment and of the user.

The initial estimation of the potential market for DOREMI solutions and services, impacts two typologies of health care systems that are considered as most promising in terms of a potential market. They are:

- Countries with a continental health care systems, where the most promising markets would be Germany, France and Belgium. Together they represent more that 30% of the overall European population, with about 30 million individuals aged 65+ that constitutes the biggest market for DOREMI products, especially if it is considered that the higher aged population in these countries has a low level of HLY (between 5 and 10 as described in paragraph 4.3), a significant degree of media literacy and a high percentage living alone (see also paragraph 4.3).
- Nordic, NL and UK countries, representing the second best market for DOREMI products with about 15 millions of individuals aged 65+ years, only considering the most relevant countries that belong to this type of health systems such as UK, The Netherlands, Denmark and Finland. Also for this market the higher aged persons have a low level of HLY, a significant level of media literacy and a large part of them living alone.

## 1.4 The address of the project public website

<http://www.doremi-fp7.eu>