



FINAL PROJECT REPORT

– Template –

Please send this report ELECTRONICALLY to the Central Management Unit (CMU) as well as a copy to the National Contact Persons (NCPs) of the coordinator and project partners

The coordinator of the project must submit this report within 60 calendar days after the final date of the project, on behalf of the consortium.

***If you have any additional question,
please contact the AAL CMU at CMU@aal-europe.eu,
or your NCP (see details on www.aal-europe.eu/aal-ncp)***

Report date

23/01/2015

PUBLISHABLE PROJECT INFORMATION (TO BE USED BY AALJP)

1A. PROJECT	
Project full title	NATURAL COMMUNICATION DEVICE FOR ASSISTED LIVING
Project acronym	NACODEAL
Project No.	AAL-2010-3-116
Project Website	www.nacodeal.eu
Project duration	• Starting date: 01/10/2011 • Termination date: 01/12/2014
Coordinator's name and details	Full name: Maite Cobo Abeytua E-mail address: maite.cobo@itcl.es * Telephone number: 947298471 * <i>* Both e-mail address and tel. number must be provided.</i>

1B. PROJECT PARTNERS					
No.	PARTNER ORGANISATION NAME	PARTNER ORG. ACRONYM	TYPE*	PROJECT COSTS: PUBLIC GRANT IN EURO	PROJECT COSTS: PARTNER OWN CONTRIBUTION IN EURO
1 (coord.)	Instituto Tecnológico de Castilla y León	ITCL	RTD	325.223,50	368.004,39
2	IBERNEX Ingenieria S.L.	IBERNEX	Large	228.640	342.960
3	COOSS Marche Onlus	COOSS	END USER	201.906,25	273.372,75
4	E-Seniors	ESENIORS	END USER	196.382	196.381
5	Imaxdi Real Innovation S.L.	IMAXDI	SME	268.452	178.968
<i>*Please select one of these options: SMEs, Large, END USER, RTD, other</i>					

1C. PUBLISHABLE PROJECT RESULTS SUMMARY (1 PAGE)

NACODEAL products try to provide a new type of easy-to-use technology tool for elderly people, so to enable them to actively face challenges related with TICs usability while keeping them connected to today's Information Society. NACODEAL is intended to provide a guidance service by using Augmented Reality Technologies to enable elders to be self-sufficient despite their memory diseases.

NACODEAL has generated a portable device in which an Augmented Reality module will be integrated which, in turn, creates friendly guides so that its users will be capable of performing their daily activities and access online services which are relevant to them.

The NACODEAL modular infrastructure can be divided into the following main components:

- Portable device (DCPAR) with Augmented Reality system
- Support software
- Tools (For Caregiver + User)

The target population of NACODEAL consists of people over 60 years old and with the following requirements:

- Ability to move independently in the spaces used for the validation;
- Good physical self-sufficiency;
- Presence of good cognitive abilities or mild and temporary memory loss.
- People in the scale from CDR0 to CDR1 within the Clinical Dementia Rating (CDR) scale

The target payers are relatives (informal cares that will pay for the NACODEAL system in order to enable longer independent lives for the people whom they care of.

The project results will be, mainly, exploited in the following sectors: Nursing Home Services; National Social Care Systems; Social care services and products providers; Telecommunication companies; Insurance companies; R&D institutions; Health monitoring service providers.

The technological innovation of the created products consists mainly in the approach used to the creation and projection of the guides to the elderly. Beyond already existing uses of Augmented Reality technologies (advertising, architecture, entertainment, navigation devices, etc...) the project has taken advantage of its strengths for creating natural guides for elderly as "a digital caregiver". These Augmented Reality technologies are integrated in a portable device which is able to determine the position of the end User in his/her home without the use of external sensors. This approach thanks to the great development of the technology will be of great use and will enable a completely different approach to the paradigm of assisted living.

This system is an innovative ICT-based solution for the ageing population, contributing to improve the quality of life, autonomy, skills of this segment while reducing care costs of public healthcare. The NACODEAL system has been conceived to be versatile and scalable, in the future the device may become a base for further services than those studied during the project. And although it has initially been tested in people with memory loss, actually any person can use it to improve self-confidence and ones capacity to remember and fulfill ones daily tasks/routine. The pilot phase (Validation) demonstrated the potentiality of Augmented Reality in assisting independent life of elderly people, also in promoting and maintaining safety of home environment as well as in stimulating social interaction through memory alerts.

In consequence, the user range of the device can be diverged after the project period; the use of the NACODEAL is not specifically limited to one type of elderly sub-group since the solution can be easily adapted to other end-user needs. A number of possible future services to be integrated in the same device are shown hereafter: People recognition services (identification of trustable people, friends...); Motivation services (Helping the elderly to keep moving into the world sharing experiences, coaching professionals...); Edutainment & Health services (Leisure and useful activities for a healthy life style...); Telephony services...

At the current stage, January 2015, the Consortium does not see an exploitability of the complete NACODEAL system on short term (within a 2-year time frame), at least 2 more years of research are required in order to provide the final user with a real portable system which has become the weakest point of the NACODEAL system and after a viable prototype at least 2 more years to reach the final market will be requested.

CONFIDENTIAL PART OF THE REPORT

2. DELIVERABLES SUBMITTED AND MILESTONES ACHIEVED DURING THE PROJECT

It has been required 8 months delay for the project that where agreed by the commission, apart from that all deliverables and milestones have been achieved.

Has the project been finalised in line with the Description of Work?

YES ☐

NO ☐

PARTLY ☒

AS EXPLAINED ABOVE THE PROJECT REQUIRED 8 MONTHS DELAY DUE TO THE DIFFICULTIES IN CREATING THE HARDWARE AND SOFTWARE OF THE NACODEAL AUGMENTED REALITY SOLUTION

Has the project achieved its expected results as described in the Description of Work?

YES ☒

NO ☐

PARTLY ☐

IN CASE OF DEVIATION, PLEASE EXPLAIN:

3 A. PROJECT RESULTS - SCIENTIFIC/TECHNICAL PROJECT RESULTS

Provide a summary of the confidential results, including:

- The progress per work-package
- The performance of the project consortium (added value of cooperation, added value and performance of each partner etc.)
- Scientific/technical achievements during the course of the project
- End-user services developed during the course of the project
- Other confidential information

The general progress of the different work packages during the project has been correct although there was a delay in the project suffered during the execution of the tasks. This delay has been due to the difficulties founded to understand the end-users needs and requirements highlighted during the Review of the project, so as for the difficulties founded regarding the Augmented reality techniques and the real status of the developments used for this purposed as literature. It has been necessary to find new ways of developing the tasks related with this point and a delay on the trials has also been given.

The consortium has worked as a well coordinated team where all the required knowledge has been present all through the different stages of the project, the initial requirements from the End Users was determined thanks to the two end users organizations and the inclusion of End Users point of view all over project realisation. Initial applications and software development of the tablet was developed by IMAXDI, and organization with great Knowledge in this type of developments. Augmented reality and indoor tracking system was created thanks to the ITCL expertise and the hardware to provide this new solution to the end users was created thanks to the Ibernex manufacturing knowledge.

The technical achievements can be divided in three parts:

- Development of software solution; designed the user interface (UI) of the application deployed in the tablet, according to the criteria and requirements drawn from interviews with carers and users. Three parts have been created: the tablet user interface, the internal functionalities that make possible that the

defined user interface works properly. For that, the architecture design of the device, with the definition of the database schema, the description of the modules and the interfaces between them, and the data management and storage have been defined. 2) Also the Nacodeal server architecture, with the definition of the backend services, the definition and description of the database schema, and the communication with the tablet and the augmented reality module through web services as well have been created. 3) The last part is the Web User Interface and the Services exposes to the NACODEAL system users. Through the user interface, relatives, caregivers, etc, can interact with the end user through the different services (talk, chat, pictures, music, videos, news, TV channels) and perform the device customization as well.

- Development of Augmented reality solution The NACODEAL ARS Infrastructure has two components: 1) The local infrastructure, to be installed in the location where the NACODEAL ARS will be available (residences, health-care centres, hospitals, etc.) and 2) A remote infrastructure, which can be situated at any location accessible by internet. 2) The Augmented Reality Services (ARS) modules allows the integration between the Indoors Environment Mapping/Recognition and Tracking modules, Surface Projection modules and the tablet and hardware solutions , in order to fulfil the functionalities defined in the NACODEAL project.

- Development of Hardware for the DCPAR which is a portable device, designed to be carried on by the user at home. Integrated videocamera captures the images which the user is seeing. When the system decides it is necessary, a picoprojector sends video sequences with messages for the user on the home surfaces (wall, door...) while the loudspeaker produces the related audio.

For the correct functioning, both systems (camera and picoprojector lenses) must be as close as possible of the user eyes. The device captures images and supplies video and audio but doesn't run any computational process related to AR algorithms or 3D render, only sends and receives audio and video trough wireless communication, avoiding a high computational capacity into the portable device which would need high power consumption and a heavy battery. The design tries minimizes, as much as possible, size and weight to improve the device portability. In order to reduce the power consumption, the device includes an accelerometer which define if the user is moving or not; if the device is not detecting any movement for a defined time, the system enter in low consumption status, switching off all components of the device except the processor and the accelerometer (very low consumption needs). All the development has used as a base the criteria to minimize cost of the final product.

The End-users services that have been developed during the project can be summarized as a deep evaluation of the possible users of the Nacodeal solution, their needs and expectation regarding the solution. This information has been used for the development of the NACODEAL hardware and software trying to make it as similar to the requirements as technically viable at the prototype development stage. This is intended to reduce the natural rejection of the user groups in future tests. At the same time a definition of the specific content to be incorporated in the different services has been performed Two different type of contents have been created, the static content that won't be modified during the pilot (videos, documents, helping guides, voice records, development adapted interface menus...). This content is common to every device so it is needed to generate a very useful and standard content suitable to every kind of end-users. And a dynamic content which is flexible, variable and multichannel. (Agenda reminders, information of the user...). Both static and specific contents have been defined according to the requirements highlighted by end users during the Needs Analysis, and sessions of assessment of coherency have been realised (focus group).

Once developed the Validation Plan (the strategy for experimentation and validation of the NACODEAL solution), the pilot sessions started promoting a sort of tutoring services for the end-users, aimed at selecting the users, accompanying them within the validation, preparing the environments, introducing and explaining the solution, training to its use and collecting feedbacks, toward the final users (elderly people), their informal caregivers (family members) and their formal carers (nurses, assistant, etc.).

3 B. PROJECT RESULTS – BUSINESS MODELS & INDICATORS

The Business model selected for our product/service has been the Canvas model (Alex Osterwalder). The Business Model Canvas is a strategic management template for developing new or documenting existing business models. It is a visual chart with elements describing a firm's value proposition, infrastructure, customers, and finances. It assists firms in aligning their activities by illustrating potential trade-offs.

As explained previously the NACODEAL modular infrastructure can be divided into the following main components:

- Portable device (DCPAR) with Augmented Reality system
- Support software
- Tools (For Caregiver + User)

The exploitation objects defined have been two:

- Individual modules or a combination of them;
- Individual services/applications or a combination of them.

The value propositions approached defined has been:

- Quantitative- price and efficiency
- Qualitative- overall customer experience and outcome

The main exploitation target is the European market, due to the scope of the project, the users focused and the project consortium. Nevertheless, world-wide exploitation activities will also be undertaken, mainly using the consortium partners' existing networks

The project results will be, mainly, exploited in the following sectors:

- Nursing Home Services;
- National Social Care Systems;
- Social care services and products providers;
- Telecommunication companies;
- Insurance companies;
- R&D institutions;
- Health monitoring service providers.

The approach to these sectors will be, in a first stage, through early adopters. They will be, by the means of the project results, able to develop new products and/or services. These first stage stakeholders must have a strong and widespread presence. Again, the consortium partners' network will be the first driver. Next, specialized companies that act in the aforementioned scenarios, seeking new and added value to their products will be targeted. In a third stage, smaller companies and consultants will be addressed. In the final stage the NACODEAL product will be mature and ready to enter the mainstream market.

Please answer the questions below, if possible:

What is the **targeted range of manufacturing/service costs** per product/service unit (€, € per month etc.)?

6,500 € investment cost plus 60 €/month for the service for the DCPAR.

For the NACODEAL Cloud Services it has been estimated a initial cost of 1000 €/year per provider ISP server

What is the **estimated size of the targeted market** in Europe for your product/service (in €)?

These amounts will be evaluated in a posterior market study, due the differences in the elder assistances and cultural approaches in EU.

In your business model, **who will pay** for the product/service (you can tick more than one box):

- ☒ End user (older person)
 ☒ Informal carers
 ☒ Formal care providers
 ☒ Public subsidies
☒ Insurance
 ☐ Other (add if necessary)
 ☐ not yet decided

In your business model, who will take the decision about purchase of the product/service (you can tick more than one box): ☒ End user (older person) ☒ Informal carers/family ☒ Formal care providers ☐ Public subsidies ☒ Insurance ☐ Other (add if necessary) ☐ not yet decided	
At what stage of development are you with your product/service (e.g. research, pilot, real life trial etc.)?	The DCPAR Could at this stage of the project be defined as Pilot whilst the NACODEAL Cloud Services is a fully functional precommercial services. It will be necessary to develop additional services detected in the pilots.
When will your product/service be ready for market ?	Regarding the DCPAR 2 years, based on the pico projector evolution and the cloud service no sooner than 12 months.
What type of further research/development is necessary to finalize the product (technical, adoption, market research etc.)?	Technical evolution and a market research to adapt the services development to the cultural aspects of each countries in EU
What further investments are necessary to launch product on the market?	For the DCPAR it will be necessary to see the evolution of picoprojectors related to other products (e.g. mobile phones). For the NACODEAL Cloud Services, IMAXDI had estimated an additional investment of 75K €.
Which is the expected turnover to be generated by your product/service in 2-3 years?	Based in the IMAXDI's market experience, for the first 2 years the expected turnover would be 125.000 to 175.000 €.
It is shown that current trends in the evolution of the population in Europe show a progressive aging. At the same time, the digital break is being diluted and older people are using smartphones in their daily activities useful. At first market analysis, the estimated niche could be the entire population over 75 years living alone, regardless of the degree of functionality they have. For the NACODEAL Cloud Services will not necessary any certification to gain the market. Additional services that can be foreseen for the implementation of the NACODEAL solution within the market can be: Care Taker Site/Call Centre, as Info-point and Operational Central able to collect information about utilisation of NACODEAL, supporting the users in daily management and interaction with it; Service of Installation of user profile and Updating/upgrade of information, as technological support/assistance for users both in initiation of the service as well as in continuing utilization.	

3 C. PROJECT RESULTS – END USER INDICATORS

In the section below, please provide the information you have gathered during your project on **primary, secondary and tertiary end-users¹** of your product/service. Note that secondary end-users can be formal and informal carers (see footnote). For the indicators cited below, please provide information if available; any other qualitative or quantitative information on beneficiaries can be provided instead.

Type of end-user (primary, formal and informal secondary, tertiary end-users)	The primary target group of NACODEAL are seniors who are over 60 years old and who may suffer from light cognitive trouble. As a non-medical preventive tool, NACODEAL does not target the older patients who suffer from serious cognitive trouble Secondary stakeholders are: relatives and family members, formal and informal carers, Medical Doctors, neighbours; whilst Tertiary stakeholders are: health and care services providers (public and private), Social Welfare System, Health System, Insurance sector, responsible and coordinators of health and care services.
Total number of end-users involved (by type of end-user, gender, etc.)	The pilot was carried out in France and in Italy with a total number of 21 participants (see DELIVERABLE 8.3 for more details).....
Average age and age distribution of involved end-users	The tests of the NACODEAL product have been performed with seniors over 60 years although elder or younger people can also benefit from the solution
Location of end-user (rural, town, large city, etc.)	All type of location of the end users can be approached with the NACODEAL solution (rural, town, large city, etc.)
Situation of end-users (single household, family setting, independence, etc.)	The test has been carried and validated for all type of situations of the end users single household, family setting, independence, etc
Health status (disabilities, mobility, cognitive function, etc.)	Older, active user without major restrictions and Older, inactive user with restrictions can

1 Definition of end-users in AAL Joint Programme:

- *Primary end-user is the person who is actually using an AAL product or service, a single individual, “the well-being person”. This group directly benefits from AAL by increased quality of life.*
- *Secondary end-users are persons or organisations directly being in contact with a primary end-user, such as formal and informal care persons, family members, friends, neighbours, care organisations and their representatives. This group benefits from AAL directly when using AAL products and services (at a primary end-user’s home or remote) and indirectly when the care needs of primary end-users are reduced.*
- *Tertiary end-users are such institutions and private or public organisations that are not directly in contact with AAL products and services, but who somehow contribute in organizing, paying or enabling them. This group includes the public sector service organizers, social security systems, insurance companies. Common to these is that their benefit from AAL comes from increased efficiency and effectiveness which result in saving expenses or by not having to increase expenses in the mid and long term.*

	benefit from the NACODEAL solution.
Socio-economic background (education, income class, etc.)	Any socioeconomic background can benefit from the NACODEAL solution.
Total number of end-users effectively using the AAL solution beyond the project implementation period	0
Any other information	
COOSS Marche for Italy and E-Seniors for France have been the responsible for definition of ethical plan, implementation of privacy setting, management of data gathering (i.e. data controllers) and identification of the Exit Strategy. All those recommendations, statements and resulting analysis have been incorporated in the NACODEAL project realisation, namely have been included in work packages mostly oriented to end-users, such as User Needs Analysis and Pilot Validation. All data has been processed in respect with the European Personal Data Protection Directive (Directive 95/46/EC). The directive sets out compulsory rules for the protection of individuals and the handling of personal data. As for the data protection, a codification procedure has guaranteed the anonymity of the users participating to the trials. The list of names associated to the codes has been kept by COOSS and E-Seniors research staff only. In all technological systems offered for elderly one of the fundamental ethical principles is that people should know the system they are using. This called the principle of transparency, meaning that the functionality of the system, the purpose, and intention should be described in the best possible way to its users.	

3 D. PROJECT RESULTS – OTHER INDICATORS	
Patents , which are the direct result of the project work	None
Other Intellectual Property Rights (IPR) resulting from the project work	REGISTRO DE SOFTWARE: BU-97-14. NACODEAL Tracking and recognition libraries
Collaboration to standards , which are the direct result from the project work	None
Publications (scientific or other) , which are the direct result from the project work (please provide details)	• Rafael Saracchini, Carlos Catalina Ortega An Easy to Use Mobile Augmented Reality Platform for Assisted Living Using Pico-projectors, Lecture Notes on Computer Science – Computer Vision and Graphics, 8671, pp 552-561, Springer International Publishing. • Carlos Catalina Ortega, Maite Cobo, Rafael F.V. Saracchini, Nacodeal Natural communication device for assisted living; Congreso: Investigación en envejecimiento: Una respuesta multidisciplinar • Cobo Maite, Catalina Ortega Carlos; Natural Communication Device For Assisted Living NACODEAL; Congreso: Ambient

	Assinted Living Forum 2012. • Bordoni Luca “NACODEAL: il dispositivo tecnologico che facilita la memoria”, NumeroZero (COOSS Marche house organ), February 2012 • Bordoni Luca, Scocchera Francesca “Elderly with temporary memory loss: the NACODEAL scenario”, Bilbao (ES), AAL Summit, June 2012 • Article about NACODEAL A.R. in the Health magazine SenzaEtà, N°57, May-June 2013; • Bordoni Luca, Scocchera Francesca “Domotica e servizi per persone anziane: l’esperienza di NACODEAL e degli altri progetti di ricerca”, Riva del Garda (IT), X Workshop sull’Impresa Sociale, September 2012 • Bordoni Luca, Scocchera Francesca “Un sostegno tecnologico per i problemi temporanei di memoria: lo scenario italiano di NACODEAL”, Parma (IT), ForitAAL October 2012 • Bordoni Luca “Le immagini come support all’autonomia dell’anziano: la realtà aumentata”, NumeroZero (COOSS Marche house organ), November 2012 • Bordoni Luca, Scocchera Francesca “Social interaction evaluation during the testing of AAL solutions: NACODEAL case study”, Norrköping (SE), AAL Forum, September 2013 • Bordoni Luca, Scocchera Francesca “NACODEAL technologic system in supporting self-sufficiency of elderly people”, Ancona (IT), ForitAAL October 2013 • A La Ginestra di Chiaravalle nuove tecnologie per rendere più autonomi gli anziani”, Chiaravalle informa (local newspaper, August 2014 • “Tablet e pico-proiettore. E l’anziano è online”, Corriere Adriatico (local newspaper), September 2014.
Other dissemination activities	The NACODEAL project has been disseminated according to the dissemination plan among stakeholders, possible industries, end users in different media such as internet, radio, television, publication, congresses etc.
Type and size of audience reached by dissemination activities	More that 1000 persons from different environments.
Technology transfer agreements and/or any other business deals achieved	COOSS signed an agreement with the University of Camerino (in Marche region) in November 2014, stating the full cooperation amongst the two in developing ICT solutions for ageing population, matching the Research of the University with the Innovation of the private enterprise. The achievement of the agreement was possible also thanks to NACODEAL, as for the role of COOSS as pilot site
Spin-off/s set up	0
Number of jobs created	2

4. FINANCIAL INFORMATION - OTHER COMMENTS

Please check appropriate box:

*The financial part of the project **X** is in line with (or) ☐ deviates from the partner's Grant Agreements & Work Packages plans (personal efforts, other costs, etc.)?*

In case of deviation, please give a short explanation:

.....

Other comments related to financial part of the project:

.....

5. AAL JP PROGRAMME

The main advantage of working in this AALJP project has been the close cooperation with users as core philosophy with a Multidisciplinary approach. The possibility to carry out a research project of a complex system but with multiple uses and benefits for the final users under a user-drivenness, user-centeredness approach.

It has been an excellent opportunity to network with and learn from the experiences of international actors in the field of AAL, learning about the experiences of long-term user trials of our partners (COOSS and ESENIORS) and an opportunity to share our expertise in a consortium.

No disadvantages have been detected.