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**ANNUAL REPORT 2012**

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## Associação Fraunhofer Portugal Research

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### Research of Practical Utility lies at the heart of all activities developed by Fraunhofer Portugal

Founded in 2008 – as a result of the long term Portuguese-German collaboration in Science and Technology – Associação Fraunhofer Portugal Research focuses on companies as customers and partners to promote innovative product development by delivering applied research results in an international context.

Adopting the well tested – and undisputedly successful – model operated in Germany by Fraunhofer-Gesellschaft, Fraunhofer Portugal supports economic development and social wellbeing by contributing to the population’s quality of life.

Currently, the Associação Fraunhofer Portugal Research (Fraunhofer Portugal) owns and operates the Fraunhofer Portugal Research Centre for Assistive Information and Communication Solutions (Fraunhofer AICOS) – a partnership between Fraunhofer-Gesellschaft and the University of Porto – focusing on Ambient Assisted Living (AAL) and Information and Communication Technologies for Development (ICT4D).

Acknowledged by the Portuguese Government as an “Entity of Public Interest”, the Associação Fraunhofer Portugal Research was named after Joseph von Fraunhofer (1787-1826), the illustrious Munich researcher, inventor and entrepreneur.

### A investigação de utilidade prática está no centro de todas as actividades desenvolvidas pela Fraunhofer Portugal

Fundada em 2008 – e resultando de uma colaboração de longo prazo em Ciência e Tecnologia entre Portugal e a Alemanha – a Fraunhofer Portugal mantém um enfoque nas empresas como parceiros, promovendo e desenvolvendo atividades de investigação aplicada num contexto internacional.

Adotando o bem-sucedido modelo de negócio operado na Alemanha pela Fraunhofer-Gesellschaft, a Fraunhofer Portugal apoia o desenvolvimento económico e promove o bem-estar social, ao contribuir para a melhoria da qualidade de vida das populações.

Neste momento, a Associação Fraunhofer Portugal Research (Fraunhofer Portugal) detém e opera o Fraunhofer Portugal Research Centre for Assistive Information and Communication Solutions (Fraunhofer AICOS) – uma parceria entre a Fraunhofer-Gesellschaft e a Universidade do Porto – dedicada às áreas de “Ambient Assisted Living” (AAL) e de Tecnologias de Informação e Comunicação para o Desenvolvimento (ICT4D).

Reconhecida pelo Estado Português como Pessoa Coletiva de Utilidade Pública, a Associação tem o nome do famoso cientista, inventor e empreendedor Joseph von Fraunhofer (1787-1826), originário de Munique, Alemanha.

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# **ANNUAL REPORT 2012**

### **Fraunhofer Portugal: United for Innovation!**

The past year of 2012 resulted in very positive returns on our scientific and strategic investments and the best results ever achieved, despite the unexpected difficulties encountered and which impacted on the planned growth rate.

The most prominent and important achievement of 2012 was the excellent first evaluation of the first four years of operation. Consequently, the evaluation committee, composed of eleven internationally renowned experts, unanimously recommended the continuation of Fraunhofer's operations.

During the evaluation process, we presented our most recent R&D activity results to the evaluation committee. The results not only convinced the evaluation committee, but were distinguished with awards in international contests. In 2012, Associação Fraunhofer Portugal Research (Fraunhofer Portugal) won awards in the following contests:

- 1<sup>st</sup> prize "Young researcher of the Year in AAL" in the "EU AAL Forum", Eindhoven, with the Melanoma Detection project;
- 1<sup>st</sup> prize in the "ESNC<sup>1</sup> competition", Munich, with the ULF-MC project;
- Portugal' Nominee by APDC<sup>2</sup> to the "World Summit Awards", Abu Dhabi, with the AlzNav project;
- Top-25 Apps in the "CES<sup>3</sup> Mobile Apps Showdown", Las Vegas, with the Dance! Don't Fall project;
- Honorable mention in the "VodafoneMobile Data Challenge", Lisbon, with the Postbox Web project.



This success story continues in 2013: at the time this report is being written, Associação Fraunhofer Portugal Research (Fraunhofer Portugal) is already among the winners of the “E-Inclusion and Empowerment” category in the “World Summit Awards” and is a finalist in the “GSMA mWomen Design Challenge”, which will take place in the “Mobile World Congress 2013” in Barcelona.

In 2012, our project revenue increased 48%, including a 67% increase in industry revenue when compared to 2011. At the end of 2012, our team was made up of sixty three people, including twenty students, seven service providers and one visiting scientist.

Nonetheless, we were able to start new projects, with new industry customers, namely with Bosch Termotecnologia, a branch of the Robert Bosch GmbH. This is a good example of how Fraunhofer can serve German industry internationally. An additionally positive and important aspect is the inclusion of two important Portuguese industry players – Efacec and Efapel - in a project consortium with Bosch, in a commercial relationship which was inexistent until this moment. As the project is based on the Fraunhofer Portugal initiative, and aside from the innovative aspects, we consider this to be a positive contribution to the increased competitiveness of Europe, which in turn is also the basis for German and Portuguese industry exports within Europe.

The current year of 2013 will be a crucial milestone for our development, as it will bring a final decision for our strategic development plans for the competence centers, and will show our ability to leverage the investments made in the award winning internal R&D activities. The first successful step has been a contract with a company from the Netherlands which, in addition to a R&D project, contains a license for background knowledge, i.e., the result of our internal research projects.

On a final note, it is our hope that this year is less influenced by political incidents and that the market opportunities AICOS is addressing will develop as planned, leading to an increased innovation activity of our national, German and international customers, and in this way contributing with an opportunity to grow and offer our competences as professional and motivated R&D service providers.

**Dirk Elias**

- 1 *ESNC - European Satellite Navigation Competition*
- 2 *APDC - Portuguese Association for the Promotion of Communications*
- 3 *CES - Consumer Electronics Show*



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### Fraunhofer Portugal: Unidos pela Inovação!

O ano de 2012 trouxe um retorno bastante positivo do nosso investimento científico e estratégico, resultando no melhor ano de sempre, apesar de termos encontrado dificuldades inesperadas que tiveram um impacto nas taxas de crescimento planeadas.

A nossa conquista mais proeminente e importante em 2012 foi o excelente resultado obtido na primeira avaliação após os primeiros quatro anos de operação. Consequentemente, a comissão de avaliação, composta por onze especialistas de renome internacional, recomendou por unanimidade a continuação da nossa operação.

Durante a avaliação apresentámos os resultados mais recentes das nossas atividades de I&D. Não só os resultados foram convincentes para a comissão de avaliação, como também, em muitos casos, nos permitiram conquistar prémios em competições internacionais. Em 2012, conquistamos prémios nas seguintes competições:

- 1.º Classificado “Young researcher of the Year in AAL” no “EU AAL Forum”, Eindhoven, com o projeto Melanoma Detection;
- 1.º Classificado na “ESNC<sup>1</sup> competition”, Munique, com o projeto ULF-MC;
- Nomeado pela APDC<sup>2</sup> como candidato por Portugal ao “World Summit Awards”, Abu Dhabi, com o projecto AlzNav;
- Finalista no “Top-25 Apps” no “CES<sup>3</sup> Mobile Apps Showdown”, Las Vegas, com o projeto Dance! Don’t Fall;
- Menção honrosa no “Vodafone Mobile Data Challenge”, Lisboa, com o projeto Postbox Web.



Esta história de sucesso parece ter continuidade também em 2013, uma vez que, até à data em que este relatório está a ser redigido, estamos entre os vencedores da categoria “E-Inclusion and Empowerment” na “World Summit Awards” e entre os finalistas no “GSMA mWomen Design Challenge”, que decorrerá no “Mobile World Congress 2013” em Barcelona.

Em 2012, as nossas receitas de projetos cresceram 48%, destacando-se um aumento de 67% nas receitas de projetos com a indústria, em comparação com 2011. No final de 2012, a nossa equipa era composta por sessenta e três colaboradores, incluindo vinte alunos, sete prestadores de serviços e um cientista convidado.

Por outro lado, conseguimos iniciar novos projetos com novos clientes industriais, um dos quais é a Bosch Termotecnologia, sucursal da Robert Bosch GmbH. Este é não só um bom exemplo de como a Fraunhofer pode servir a Indústria Alemã a nível internacional, como é também positivo o facto de o consórcio do projeto incluir dois importantes atores da indústria Portuguesa: as empresas Efacec e Efelap que, até aqui, não tinham uma relação de negócios direta com a Bosch. Como o projeto é baseado na iniciativa da Fraunhofer Portugal, consideramos que, para além dos aspetos inovadores deste projeto, este consórcio é indubitavelmente uma contribuição positiva para o aumento da competitividade da Europa, competitividade esta que é a base para as exportações da indústria Alemã e Portuguesa no território Europeu.

O ano de 2013 vai ser também crucial para o desenvolvimento da Fraunhofer Portugal, pois irá trazer uma decisão final para o nosso plano de desenvolvimento estratégico relacionada com os centros de competência, permitindo demonstrar a nossa capacidade de alavancar os investimentos realizados nas nossas atividades internas de I&D premiadas. Um primeiro marco de sucesso foi a assinatura do contrato com uma empresa Holandesa que, para além de um projeto de I&D, contempla ainda o licenciamento do nosso conhecimento base, i.e., o resultado dos nossos projetos de investigação internos.

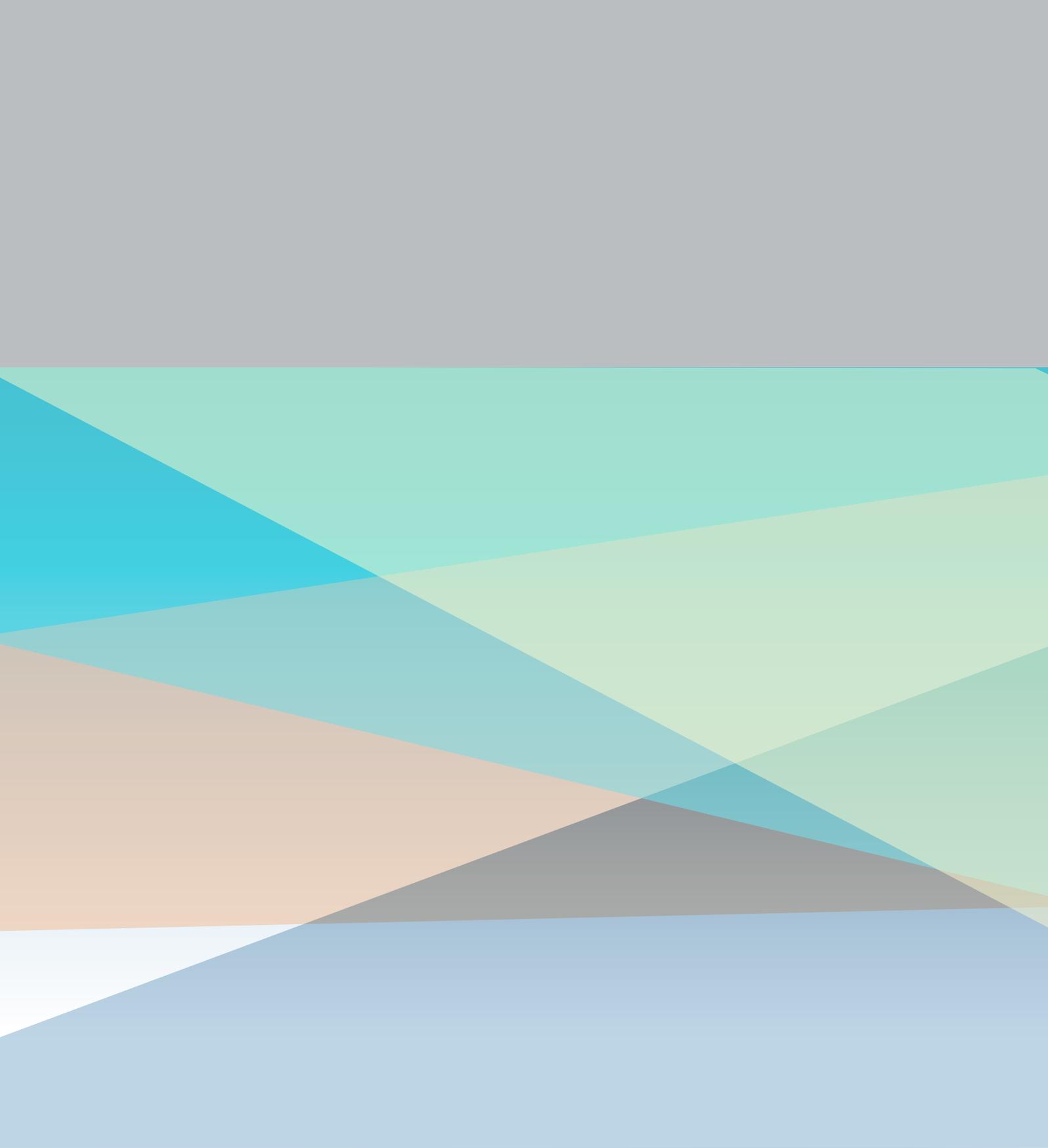
A título conclusivo, esperamos que este ano seja menos influenciado por efeitos políticos, e que as oportunidades de mercado às quais o AICOS se dedica se desenvolvam de acordo com o planeado, originando um aumento das atividades de inovação dos nossos clientes nacionais, Alemães e internacionais, contribuindo desta forma para um aumento de oportunidades, permitindo-nos colocar as nossas competências ao serviço na qualidade de prestadores de serviços de I&D profissionais e motivados.

**Dirk Elias**

**1** ESNC - European Satellite Navigation Competition

**2** APDC - Associação Portuguesa para o Desenvolvimento das Comunicações

**3** CES - Consumer Electronics Show





## **REPORT OF THE EXECUTIVE BOARD**

- 12 Governance & Management
- 16 Overview of Fraunhofer Portugal
- 21 Management Report 2012

## **REVIEW OF FRAUNHOFER PORTUGAL RESEARCH**

- 34 Strategic Research Agenda
- 40 Projects and Results 2012

## **SERVICE**

- 58 Location and Contacts

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# **REPORT OF THE EXECUTIVE BOARD**

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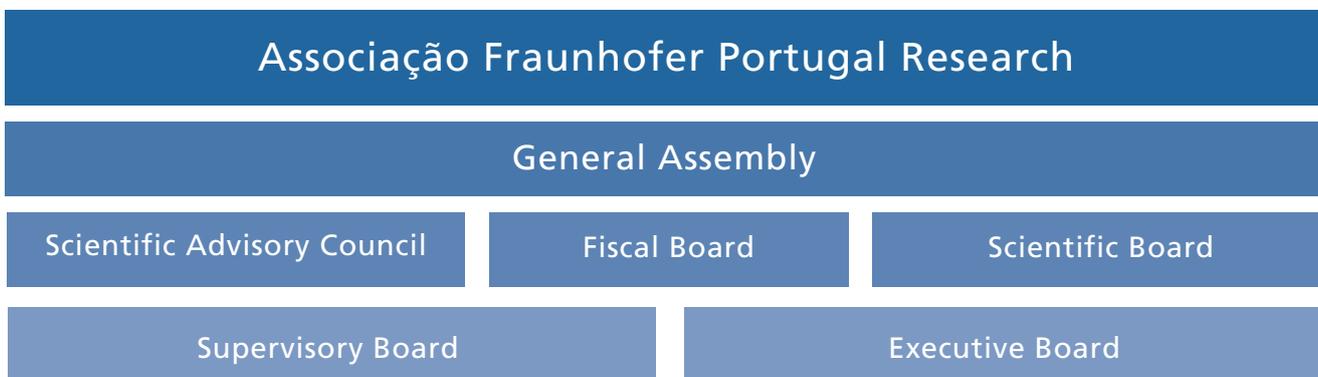
**GOVERNANCE & MANAGEMENT**

**OVERVIEW OF FRAUNHOFER PORTUGAL**

**MANAGEMENT REPORT 2012**

# GOVERNANCE & MANAGEMENT

## GOVERNANCE STRUCTURE



### Governance Structure

We seek to follow the best practices in every area of the Association's governance, reflecting such practices in our organization, principles and transparency.

The Associative Structure of Fraunhofer Portugal clearly distributes functions, duties and responsibilities among its board members.

### Management

Fraunhofer Portugal management is a shared responsibility of both the Supervisory Board (with broad assessment powers) and the Executive Board (responsible for the daily management and current management actions).

### SUPERVISORY BOARD

President

**Georg Rosenfeld**

Division Corporate Development  
Fraunhofer Gesellschaft

Deputy President

**João Paulo Oliveira**

Board of Directors  
Bosch Termotecnologia, S.A.

Member

**Paulo Simões**

Board of Directors  
Sonae - Specialized Retail, Sgps, S.A.

## EXECUTIVE BOARD

### **Dirk Elias**

President of the Executive Board

#### **Profile:**

With a professional career ranging from R&D activities to entrepreneurial experiences and management, Dirk Elias is a Dipl. Ing. in Electrotechnical Engineering by the Technical University of Munich, and holds a PhD from the Technical University of Berlin.

#### **Professional Career Summary:**

Ivistar AG: President of the Supervisory Board, until the company was sold to a foreign investor

Ivistar AG: CEO

Fraunhofer FOKUS Institute, Berlin: Senior Scientist & Deputy Department Leader

Fraunhofer FOKUS Institute, Berlin: Scientist

#### **Functional Assignments:**

General Administration

R&D Planning

Business Development

Facilities

#### **Other Roles:**

Executive Director of Fraunhofer Portugal AICOS

Invited Cathedric Professor at the Faculty of Engineering of the University of Porto

Member of the Scientific Council of the Faculty of Engineering of the University of Porto

Member of the Scientific Council of Energy in, the industrial cluster of Portuguese companies in the energy sector





**Miguel Barbosa**

Executive Board Member

**Profile:**

With a professional career initiated in technical areas and evolving to corporate and business development functions, Miguel Barbosa has an MSc in Electrotechnical and Computer Engineering from the University of Porto and an MBA from the EGP-UPBS University of the Porto Business School.

**Professional Career Summary:**

Sonaecom: Corporate Development (Corporate Strategy & Finance)

INIGraphicsNet Foundation: Business Development and Innovation Manager

Optimus: Mobile Telecommunications Network Development Manager

Siemens: Software Development Engineer

**Functional Assignments:**

Business Development

Planning & Control

Accountancy and Finances

Human Resources

Legal

Facilities

**Other Roles:**

Manager for New Business Development and Head of Administration at Fraunhofer Portugal AICOS

Invited Assistant Professor of the MSc in Innovation and Technological Entrepreneurship, Faculty of Engineering of the University of Porto

## **Berthold Butscher**

Executive Board Member

### **Profile:**

With a career highly oriented towards R&D, both in industry and in R&D institutions, Berthold Butscher holds a Dipl. Ing. in Electrotechnical and Computer Engineering from the University of Applied Sciences of Konstanz and from the Technical University of Berlin.

### **Professional Career Summary:**

Deputy Executive Director of Fraunhofer Institute FOKUS, Berlin, Germany

Deutsche Telekom Berlin, Germany: Leader of the Integrated Communication Systems Unit

Hahn-Meitner-Institute Berlin, Germany: Distributed Systems Department Chief

Hahn-Meitner-Institute Berlin, Germany: Scientist

### **Functional Assignments:**

R&D Planning Support

### **Other Roles:**

Senior consultant and evaluator for the IT innovation program (Info Society) of the Senate of Berlin and Investitionsbank Berlin



# OVERVIEW OF FRAUNHOFER PORTUGAL

## Vision

### A Driving Force in Innovation

Fraunhofer Portugal proposes a radical change regarding technological innovation in collaboration with scientific institutions in Portugal, and aims at creating scientific knowledge capable of generating added value for its clients and partners, exploring technology innovations oriented towards economic growth, social well-being and the improvement of the quality of life of its end-users.

## Mission

### Research of Practical Utility

Fraunhofer Portugal promotes applied research of direct utility to private and public institutions and of broad benefit to society, by managing and coordinating the cooperation of its research centers with:

- Other Research Institutions – such as universities and other relevant Portuguese or non-Portuguese research institutions, as well as Fraunhofer Institutes and other research centers integrated in the Fraunhofer-Gesellschaft knowledge network;
- Industry Partners – clearly perceived and understood as our main customer group, we are developing partnerships and cooperation agreements with private and public enterprises, as well as participating in business associations;
- Supporting Partners – Government Institutions and other Institutional partners.

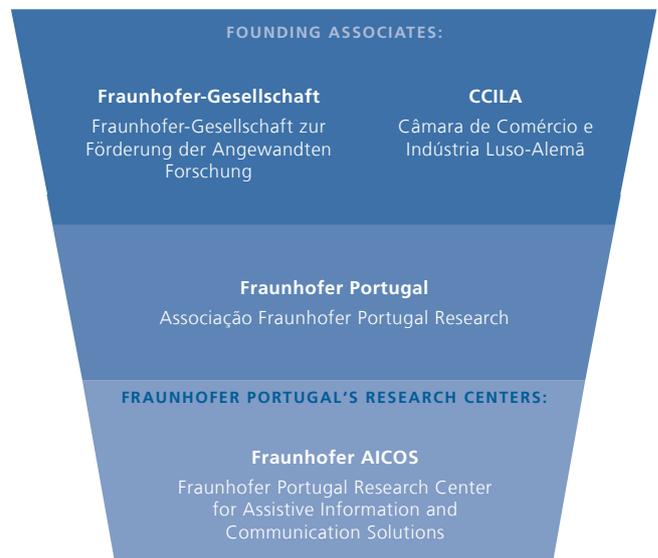
## Funding Model

Fraunhofer-Gesellschaft and FCT agreed on a tripartite funding model similar to the one used by Fraunhofer-Gesellschaft.

At Fraunhofer Portugal, our scientists and engineers work with a budget financed by external revenue (projects and licensing) and institutional funding provided by the Portuguese Foundation for Science and Technology (FCT) and Fraunhofer-Gesellschaft.

The base line for this type of funding determines that it will be granted in progressively smaller amounts over the initial years, encouraging the implementation of an efficient business model mainly financed by external revenue.

External revenues should be guaranteed through research projects, development projects, contracts celebrated with third parties within Fraunhofer Portugal's fields of activity, intellectual property rights and licensing of the commercial optimization of products and services resulting from Fraunhofer Portugal's R&D results.



### ***Fraunhofer-Gesellschaft***

Research of practical utility lies at the heart of all activities pursued by Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are requested by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft has 66 institutes and independent research units. The majority of the more than 22,000 staff are qualified scientists and engineers, who work with an annual research budget of 1.9 billion euros. Of this sum, more than 1.6 billion euros is generated through contract research. More than 70 percent of Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and Länder governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society over the next five or ten years.

Affiliated international research centers and representative offices provide contact with the regions of greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on relevant key technologies for the future, Fraunhofer-Gesellschaft plays a relevant role in the German and European innovation process. Applied research has a knock-on effect that goes beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, as well as throughout Germany and Europe. They do so by

promoting innovation, strengthening the technological basis, improving the acceptance of new technologies, and assisting in the urgently needed training of a future generation of scientists and engineers.

As an employer, Fraunhofer-Gesellschaft offers its staff the opportunity to develop professional and personal skills that will allow them to take on positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry as a result of the practical training and experience they have acquired.

The Fraunhofer-Gesellschaft is a recognized non-profit organization named after Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

### ***CCILA***

#### **German Portuguese Chamber for Industry and Trade**

With over 1000 associates in Portugal and Germany, the objective of the Chamber is to enhance and promote the economic relationships between the two countries.

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#### Associação Fraunhofer Portugal Research

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Founded in 2008 – within the framework of a long term Portuguese-German collaboration in Science and Technology – the Associação Fraunhofer Portugal Research (Fraunhofer Portugal) promotes applied research that drives and encourages economic development and serves the wider wellbeing of society. The Association's services are sought out by customers and contractual partners in industry, the service sector and public administration.

Currently, Fraunhofer Portugal owns and operates the Fraunhofer Portugal Research Center for Assistive Information and Communication Solutions (Fraunhofer AICOS) – a partnership between Fraunhofer-Gesellschaft, Fraunhofer Portugal and the University of Porto – focusing on Ambient Assisted Living and Information and Communication Technologies for Development.

Fraunhofer Portugal's development strategy accommodates the option to establish additional research units whenever a sustained demand for R&D services applied to a determinate area of scientific knowledge is detected in the market.

#### Services

Fraunhofer Portugal's Research Services, rendered through the research institutions it operates, provide three different types of collaboration to industrial customers which will also be provided within public funded project participations:

- Contract R&D;
- R&D Consulting;
- Living Labs.

Fraunhofer Portugal is committed to building a reputation of excellence within different service dimensions as invaluable as knowledge, credibility, professionalism, creativity, flexibility, response time, and cost.

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#### Fraunhofer AICOS

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#### Fraunhofer Portugal Research Center for Assistive Information and Communication Solutions

Incorporated as a partnership between Fraunhofer-Gesellschaft and the University of Porto and focusing its activity on Ambient Assisted Living (AAL) and Information and Communication Technologies for Development (ICT4D), Fraunhofer AICOS is the first research institution operated by Fraunhofer Portugal.

#### Extending the Reach of the Information and Knowledge Society

Fraunhofer AICOS aims to enhance people's living standards by offering intuitive and useful technology solutions, capable of facilitating their access to the Information and Communication Technologies, and in this way assisting in the integration of an increasingly larger sector of the population in the Information and Knowledge Society.

#### Remarkable Technology, Easy to Use

Fraunhofer AICOS' mission is to generate **Remarkable Technology, Easy to Use**. This means offering specialized competences centered on the improvement of end-user experience and usability of applications, generating applied research solutions capable of contributing to the market success of our client's products and services.

Collaboration plays an essential role in enabling the center to fulfill its mission. Therefore, Fraunhofer AICOS strongly promotes and consolidates partnerships and cooperation with key players and decision makers in its strategic research areas, namely:

- Health Cluster Portugal (organization focused on the promotion and implementation of initiatives and activities leading to the creation of an innovative and technology-based national cluster);
- Fraunhofer FOKUS (Fraunhofer Institute based in Berlin operating in closely related scientific fields, in this way pooling expertise in interdisciplinary collaborative projects as well as facilitating Fraunhofer AICOS' seamless integration with Fraunhofer-Gesellschaft in different institutional aspects);
- University of Porto (access to university know-how and infrastructures, as well as privileged contact with students interested in enrolling in advanced training at Fraunhofer AICOS labs);
- Center of Excellence for Dematerialization of Transactions (entity that coordinates a network of knowledge and competences in the dematerialization of transactions in Portugal).

#### *Strategic Research Agenda*

Fraunhofer AICOS constitutes a new approach to Information and Communication Technologies through Fraunhofer-Gesellschaft and contributes to the creation and development of competences in activities of great relevance for the future, addressing two main business fields: Ambient Assisted Living (AAL) and the emerging field of Information and Communication Technologies for Development (ICT4D).

- AAL includes methods, concepts, (electronic) systems, devices and services that are providing unobtrusive support for daily life, based on the context and the situation of the assisted person. The technologies applied for AAL are user-centric, i.e. oriented towards the needs and capabilities of the actual user. They are also integrated into the immediate personal environment of the user. Consequently, the technology is adapted to the user rather than the other way around. In order to share relevant information between systems and services, technologies for AAL should ideally be based on modular and interoperable concepts.

Fraunhofer AICOS intends to mainly address the needs of the ageing population, to reduce innovation barriers of forthcoming promising markets, but also to lower future social security costs. This goal can be achieved through the use of intelligent products and the provision of remote services, including care services that extend the time senior citizens can live in their home environment. The services envisioned and developed by Fraunhofer will increase the individual's autonomy and assist them in carrying out day-to-day activities.

- ICT4D is a general term which refers to the application of Information and Communication Technologies (ICTs) within the field of socioeconomic development or international development. ICT4D focuses on the direct application of information technology approaches to contribute to poverty reduction.

Fraunhofer AICOS currently intends to focus its ICT4D activities on the African continent, with special emphasis on Mozambique and Angola. The primary target user group will be ICT users in rural and developing areas, and the objective is to provide solutions for mobile device services and applications which meet the local users' demands, contributing to a more positive user experience which, in many cases, may be their first contact with ICT.

Among the significant amount of topics related to AAL and ICT4D, Fraunhofer AICOS focuses on a reduced set of business sub-fields that our customers consider relevant and that over the first period of operation we were able to create related within our core competences.

In the AAL business field, Fraunhofer AICOS currently covers the following sub-fields:

- Fall and Activity Monitoring;
- Chronic Diseases and Well-Being Management;
- Assistive Environments.

With regards to the emerging ICT4D business field currently only one sub-field has been defined:

- ICT4D on Mobile Devices.

Additionally, Fraunhofer AICOS supports the creation of scientific knowledge capital in three key areas that define the Center's core competences developed to date:

- Human-Computer Interaction (HCI): focusing on User & Social Experience, Mobile & Future Devices and Evaluation & Usability;
- Information Processing (IP): focusing on Content Retrieval, Context Awareness, and Multimodal Information Fusion;
- Autonomic Computing (AC): focusing on Remote Management, Control and Configuration.

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# MANAGEMENT REPORT 2012

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## Summary of Key Figures

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	<b>2012</b>	<b>2013 (Plan)</b>
Total Budget	1.893.541	2.380.000
Staff Costs	1.191.349	1.600.000
Non Personnel Costs	508.805	510.000
Industry Revenues	354.873	570.000
Public Revenues & Others	407.125	390.000
Base Funding	1.131.543	1.420.000
Number of Workers (Year End)	35	41
FTE (Full Time Equivalent)	34	41

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**Economic and Political Background**

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Five years after the beginning of the financial crisis, global economic recovery remains rather slow and irregular. In 2012, the external environment of the Portuguese economy continued to be marked by a high level of uncertainty which had a particularly adverse impact on countries undergoing adjustment processes of macroeconomic imbalances.

The adjustment process of the Portuguese economy, in 2012, evolved within the context of the economic and financial assistance program, accentuated by the international economic and financial crisis, leading to a strong decline in GDP<sup>4</sup> and to significantly higher unemployment rates.

Statistics on recent developments in the Portuguese economic activity point to a 3.2% contraction in output in 2012, the worst in recent years and the second worst in the country's history. These developments result from a sharp and broadly based decrease in domestic demand (private consumption is likely to have contracted by 5.6%), contrasting with the growth of exports observed in the course of the year. The decrease in activity strongly intensified in the second half of the year.

The State Budget for 2013 establishes a consolidation strategy essentially focused on revenue and, more particularly, on taxes on households. On the expenditure side, it envisages a number of measures, particularly the further reduction of the number of civil servants and general government investment expenditure.

The implementation of such measures is likely to play a key role in domestic demand developments with a magnitude (in real terms) expected to be close to the 2012 figures. In cumulative terms, the drop in domestic demand during the 2009-2013 period is expected to be approximately 17%. Developments in exports will continue to contribute to mitigate the impact of a decline in domestic demand on economic activity, albeit to a more limited extent in 2013. Similar in all to 2012, external demand growth is expected to be close to zero in 2013 (0.3%).

Projections for the Portuguese economy indicate that the recession experienced in the previous two years will continue in 2013 (current projections indicate a 1.9% contraction), reflecting a substantial drop in domestic demand accompanied by a slowdown in exports. This development implies a cumulative decline of 7.4 % in gross domestic product during the 2009-2013 recession. However, a restricted upturn in economic activity is expected in the second half of the year, as a result of a reversal of the decline in domestic demand.

Currently, a major challenge for Portugal is the promotion of economic development in a new institutional framework. The coherent implementation of labor and product market reforms, greater efficiency of the judicial system and the redefinition of the State's role are crucial to promote investment, innovation and technical progress; without this change, no sustainable growth is possible and, more importantly, no economic development is feasible.

<sup>4</sup> GDP - Gross Domestic Product

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## Business Evolution

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On the whole, the business evolution review reveals a number of successes and an organization which is moving with accelerating momentum - although slower than desired - in its business development activities, scientific achievements and strategic initiatives.

## Business Development

During 2012, Fraunhofer AICOS substantially reinforced its portfolio of projects, significantly grew its customer basis with important new customer acquisitions, diversified funding opportunities for applied research, and closed the year posting steadily growing operational figures and a very encouraging perspective for the following years.

The current year is starting with a very positive backlog balance and, despite the overall tempting environment, the backlog volume was increased. Notwithstanding the partial short-term impact, Fraunhofer AICOS placed 29 project proposals which come to an overall amount of circa 3.5M€ in project proposals, which have a potential impact of 3M€ in funded projects that would span for a period of two to three years. Despite the difficulties encountered with QREN, 45% of this value is represented by industry project proposals.

The strategy adopted to pre-invest in a couple of internal developments as a "proxy" to external industrial demands has increasingly generated the expected results. Consequently, current external project-related activities are often already the result of a focused project acquisition and new business development activity that was enabled by the exciting results achieved by the internal "pre-industrial" projects. We wish to highlight the national and international success achieved with the following examples:

- The internal project Shopview immediately caught the interest of "Sonae Distribuição" leading to a partnership (also involving "WeDo Technologies") in a joint project application to QREN in 2011. Although this first application was refused by QREN, "Sonae Distribuição" maintained extreme interest in the project. Therefore, the reformulation of the project was agreed on, new features were added, and the project was resubmitted to QREN in 2012 (at time this report is being prepared, the project has been approved);
- The award winning AlzNav and Mover apps caught the eye of a Dutch company and AICOS is currently licensing this technology, as background knowledge, in a project where we bundle them in a dedicated family app to be made available to senior adults in the Netherlands.

In addition to these two symbolically important acquisitions, AICOS was involved in further acquisition efforts. Immediately at the beginning of the year, four joint applications with four SMEs for a specialized (but low volume) QREN program were developed, and we were invited by the Worldbank to submit a quotation for the implementation of a crowdsourcing system in Mozambique targeting the control of public procurement activities in the educational sector which, unfortunately, was not successful.

The growing number of follow-up projects with the same industrial partners underpins Fraunhofer AICOS' success in increasingly establishing a credible profile with national and international industry partners.

AICOS was also actively involved in building consortiums and preparing proposals for different EU Calls:

- E-No Falls: ICT-CIP-PSP Program;
- ChefMyself: AAL JP Call 5;
- TeleHeart: Research for the Benefit of SME;
- ElecBus: FP7 Call Transports;
- ACP Street Libraries – culture for all: ACP- EU Support Programme for the ACP Culture Sector.

The first two projects already had positive outcomes and we are waiting for the funding decisions on the remaining projects.

Only in the last quarter of 2012 were there QREN calls with suitable profiles for our customers. AICOS teamed up with different industrial partners in four project applications for these calls.

Beyond direct project acquisition activities, Fraunhofer AICOS is working on the opportunity to create a Heart Failure Clinic with remote patient care services, together with a large healthcare system provider and Portuguese Cardiac specialists. Currently, we are discussing a QREN application with Glintt to implement the project in 2013.

In a strategic move to establish closer and longer lasting relationships with key national and international customers, AICOS hosted a number of dedicated events for SAP, Portugal Telecom and Optimus. In addition to this, we are currently discussing additional activities related to the ICT4D market with Microsoft Portugal, another key customer.

Collaboration with international industrial partners is definitely among the positive notes of 2012. The collaboration with the German industry is becoming an increasingly stronger opportunity from the point of view of source of revenue, underpinning AICOS' relevance and added value: our business fields offer a valuable enlargement of the overall Fraunhofer portfolio for German customers, our core competences complement and correspond with current research activities. German companies' subsidiaries based in Portugal see Fraunhofer AICOS as an assurance of high quality and R&D practices and standards in Portugal, as well as a privileged form of access to the Fraunhofer network. For Portugal-based customers, Fraunhofer AICOS contributes by facilitating communication and coordination as well as offering local know-how and competence.

## Scientific Results & Corporate Development

Fraunhofer Portugal's public awareness, leveraged by the success of our scientific and corporate development projects, continues to increase at a motivating and encouraging pace. AICOS' scientific team has established a solid and respected reputation amongst players in the Portuguese scientific community and within our research fields.

Pursuant to the Cooperation Agreement signed in 2009 between FCT and FhG, AICOS' activities were evaluated by a panel of international notorious experts. This was in fact the most prominent and important achievement of 2012. AICOS was evaluated as excellent.

The evaluators specifically commented on the excellence of AICOS staff with regards to scientific quality, application orientation and Fraunhofer spirit.

Consequently, the evaluation committee, composed by eleven internationally renowned experts, unanimously recommended the continuation of our operation!

During the evaluation process, we presented our most recent R&D activity results to the evaluation committee. The results not only convinced the committee, but were distinguished with awards in international contests. In 2012, Associação Fraunhofer Portugal Research (Fraunhofer Portugal) won awards in the following contests:

- 1st prize "Young researcher of the Year in AAL" in the "EU AAL Forum", Eindhoven, with the Melanoma Detection project (p. 45);
- 1st prize in the "ESNC competition", Munich, with the ULF-MC project (p. 46);
- Portugal Nominee by APDC to the "World Summit Awards", Abu Dhabi, with the AlzNav project;
- Top-25 Apps in the "CES Mobile Apps Showdown", Las Vegas, with the Dance! Don't Fall project (p. 46);
- Honourable mention in the "Vodafone Mobile Data Challenge", Lisbon, with the Postbox Web project (p. 49).

This success story continues in 2013: at the time this report is being written, Fraunhofer Portugal is already among the winners of the “E-Inclusion and Empowerment” category in the “World Summit Awards” and are finalists in the “GSMA mWomen Design Challenge”, which will take place in the “Mobile World Congress 2013” in Barcelona. This is a very important prize as it underpins the importance of our research results to industry. The GSMA in Barcelona is “the” most important event for the mobile industry in the world.

The following table provides a summary of AICOS’ activities with an important impact on the scientific domain.

Scientific Activities	
Papers	15
Books	1
Master’s Theses	18

The “Fraunhofer Portugal Challenge<sup>5</sup>” completed its third edition reinforcing our awareness of the need to create an impressive “buzz” in formal press and informal social media (with appearances in newspapers of reference, radios, and TVs - on air/on-line – and several references in science related forums, blogs, etc.). Noteworthy is the fact that – for the second consecutive year – the PhD category doubled the number of applications.

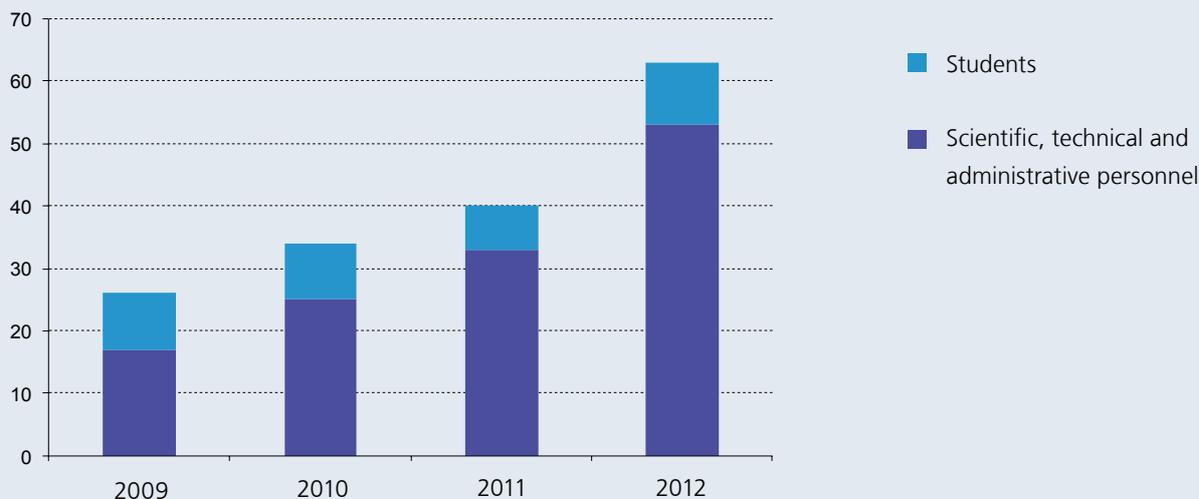
Our new office facilities, in addition to allowing us to grow and provide the team with a stimulating working environment, brought us additional recognition by being voted “Building of the Year 2011” in the “Interiors” category, by 65.000 online voters, in a competition promoted by “ArchDaily.com” - the world’s largest and most popular architectural website.

We paid close attention to the promotion of AICOS and to the raising of public awareness. In addition to these honorable prizes, which are generally promoted by the organizing institutions, we carefully select internal scientific results and other achievements that are professionally promoted in the media. On the whole, the awareness raised by our project results, the Fraunhofer Portugal Challenge, and the Relocation Project, delivered an impressive AAV<sup>6</sup> (Automatic Advertising Value ) of 469,2K€, which represents an impressive increase of 102% vs. last year.

<sup>5</sup> Scientific award rewarding MSc and PhD students from Portuguese Universities that developed “Research of Practical Utility” in their thesis

<sup>6</sup> AAV – Automatic Advertising Value: is calculated based on the price of advertising on each media that published an article on Fraunhofer Portugal

### Headcount Evolution



### Employees

Fraunhofer Portugal's success and its Human Resources policy is based on the respect for human values, merit, pro-activity, and the observance of the law, and on knowing how to reach the goals we propose ourselves, in order to achieve a motivated and united team in favor of innovation.

Throughout 2012, we were able to grow our team by 58%, closing the year with a total headcount of 63 collaborators (51% regular staff, 35% grant holders, 14% external collaborators) which corresponds to 34 FTE<sup>7</sup>. Nonetheless, this significant growth has been accomplished in a sustainable manner, always assuring optimum working conditions for the team, both in terms of office facilities and IT equipment.

We operate a talented young team, and we have managed to maintain a significant gender distribution, with a 21% ratio of female collaborators. Additionally, we run a highly educated team, 90% of staff members have a university degree.

Headcount evolution is highly fluctuating during the year due to the profile of our activity and collaborations with students. We have therefore registered a peak of 78 people during the first quarter, with an average amount of 71 people throughout the year.

The positive evolution of FhP headcount registered in 2012 is a direct consequence of the rising number of research projects and contracts, revealing the Center's reputation among clients and partners is growing solidly, indicating that year after year we are building an image of quality as an R&D institution of excellence.

Furthermore, during 2012, six collaborators left Fraunhofer Portugal as a consequence of having been offered working contracts in the industry sector, as a result of the training and technical skills acquired at the Center. Once more, this demonstrates our commitment and mission to increase the innovation pace of the Portuguese Economy, contributing to its overall international competitiveness.

<sup>7</sup> FTE - Full Time Equivalent



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### Outlook and Strategic Development

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In the continued perusal of the goals defined in 2012, it is our intention to focus on the aspect **United for Innovation!**, as we perceive this to be the best possible continuous support we can give to our customers in order to overcome the challenges generated by the economic crisis.

Aside from addressing directly potential national and German industrial customers in order to provide services to help them to create new products, we do have an increasing amount of results arising from our internal projects. Many of those results are already being awarded and distinguished in important competitions. Leveraging our investment and sharing those success stories is important to receive additional attention, as the value of ideas and innovation tends to decrease rapidly over the time.

Regarding our future strategy, very valuable recommendations were made during the evaluation process and we will make an effort to establish an industrial advisory council (mainly driven by industry representatives) in order to assist us in understanding customer demands at a very early stage, but also to establish a permanent communication channel towards selected companies by demonstrating and sharing, at regular periods, the latest results of our internal R&D activities.

Currently, our flag-ship development is the smart companion, a smart phone based solution for elderly people intended to assist this target group in everyday situations. It is designed as a set of helper functionalities that are as personalized in proportion to the demanding profiles of elderly people. From this perspective, we are comparing our smart companion with a Swiss Army knife.



Smart Companion interface

At the time we are writing this report, we are on the verge of deciding to start a second flag ship development with our German colleagues: a medical diagnosis device for consumers which is capable of detecting common medical conditions. The device might become the natural extension of the Smart Companion towards mHealth. We are also currently discussing the constitution of a team made up of 6-8 German institutes and AICOS. The project will therefore provide us with an additional integration opportunity with our German Fraunhofer colleagues in order to leverage our potential, also bringing internal benefits from the international engagement of Fraunhofer.

Due to the strong relationship with sensor fusing mechanisms, the device will greatly benefit from the planned activities of the Fall Competence Center (FCC). Also, the results related to the device will have a strong impact on the activities planned within the ICT4D Competence Center (ICT4D-CC), as the existence of such a device, potentially extended to African specific medical conditions, would be a breakthrough for the management of rural community health management, which would greatly benefit from such an easy to use and automatic diagnosis device.

Therefore, the funding decision regarding the competence centers becomes more and more important for our strategic planning, as the existence of the competence centers would allow us to allocate a much larger team to the projects, thus increasing the likelihood of an outstanding result<sup>8</sup>.

Additionally, both competence centers will be the platform that will allow us to extend this scientific excellence towards a significantly larger set of solutions which are added value for industry in fields that have also been identified by Fraunhofer Germany as strategic. A good example of this is our idea to provide a dual-use activity monitoring solution based on our sensor fusion competences and implemented in COTS (Commercial Off-The-Shelf) that can help to coordinate soldiers, but also firefighters, or policemen in civil safety and security scenarios from a very interesting cost benefit perspective.

It is clear that such solutions would also help to support the vision of the German Ministry of Defense in its interest to stimulate the change of the business model of defense solution vendors in order to supply military versions of bleeding edge civil market products at a fraction of today's cost and in less time.

From the above, it is clear that AICOS is acting in a very interesting field that offers significant and diverse opportunities. We therefore strongly believe that throughout 2013 we will be able to proceed with our development towards the full implementation of the Fraunhofer Model.

<sup>8</sup> At the time we are writing this report we already have an official decision stating that both competence centers have been approved

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### Perspetivas e Desenvolvimento Estratégico

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Tal como no ano passado, queremos dedicar-nos ao lema **Unidos pela Inovação!**, pois acreditamos ser o melhor apoio a dar aos nossos clientes no sentido de ultrapassarem os desafios gerados pela presente crise económica.

Para além da abordagem direta a potenciais clientes industriais, nacionais e Alemães, com o intuito de fornecer serviços que ajudem na criação de novos produtos, dispomos também de uma crescente quantidade de resultados proveniente dos nossos projetos internos. Muitos destes resultados já nos conduziram à conquista de prémios em competições importantes. Alavancar o nosso investimento e rentabilizar essas histórias de sucesso carece de uma atenção especial, dada a rápida diminuição do valor das ideias e das inovações ao longo do tempo.

Relativamente à nossa estratégia futura, recebemos diversas recomendações valiosas ao longo do processo de avaliação e é, por isso, nossa intenção constituir um painel de conselheiros para o sector industrial (especialmente composto por representantes ligados à indústria), que nos permitem perceber e antecipar as necessidades dos nossos clientes. Simultaneamente conseguiremos estabelecer um canal de comunicação permanente, através de empresas selecionadas, em intervalos de tempo regulares, onde possamos demonstrar e apresentar os últimos resultados das nossas atividades internas de I&D.

Atualmente, o nosso projeto de referência é o Smart Companion, uma solução para seniores baseada no conceito de “smartphone”, que tem como objetivo apoiá-los em todas as situações do dia-a-dia. O projeto contempla uma vasta gama de funcionalidades de auxílio que podem ser utilizadas individualmente de acordo com o perfil de cada sénior. Nesse sentido, comparamos este projeto a um canivete Suíço.



Fraunhofer Portugal Challenge 2012 Winners

Na altura em que este relatório está a ser redigido, estamos a ponderar iniciar um segundo projeto de referência com os nossos colegas Alemães. Um dispositivo de diagnóstico médico para consumidores finais capaz de detetar condições médicas comuns. Assim, este dispositivo pode vir a tornar-se a continuação natural do Smart Companion rumo ao “mHealth”. Em debate está a criação de uma equipa de peritos oriundos de seis a oito Institutos Fraunhofer na Alemanha e do AICOS. Adicionalmente, o projeto vai possibilitar-nos uma melhor e mais intensiva interligação com os nossos colegas Alemães da Fraunhofer, alavancando assim o nosso potencial, com vista aos benefícios internos derivados do envolvimento internacional da Fraunhofer.

Devido à forte relação com mecanismos de “sensor fusing” o dispositivo vai beneficiar largamente das atividades planeadas para o Fall Competence Center (FCC). Adicionalmente, os resultados relacionados com o dispositivo irão também causar um forte impacto nas atividades que temos planeadas para o ICT4D Competence Center (ICT4D-CC), pois acreditamos que a aplicação deste dispositivo em África, quando aplicado a condições médicas específicas, representará um enorme avanço para os programas de saúde nas comunidades rurais, que beneficiarão largamente de um dispositivo de uso fácil e que permite diagnósticos automáticos.

Como tal, a decisão de financiamento relacionada com os centros de competência torna-se cada vez mais importante para o nosso planeamento estratégico, uma vez que a existência destes centros permitirá alocar uma equipa significativamente maior aos projetos, aumentando assim a probabilidade de um resultado excecional<sup>4</sup>.

Adicionalmente, os centros de competência tornar-se-ão a plataforma que nos permitirá estender esta excelência de resultados científicos a um conjunto muito maior de soluções com valor para a indústria, em áreas consideradas estratégicas pela Fraunhofer Alemã. Um bom exemplo, é a ideia de fornecer uma solução de monitorização de atividade com dupla utilização, baseada nas nossas competências de “sensor fusion”, implementada em “COTS (Commercial Off-The-Shelf)” que pode auxiliar na coordenação de soldados, mas também bombeiros ou polícias, em cenários de proteção e segurança civil, a um preço bastante competitivo.

Torna-se claro também que estas soluções contribuirão para apoiar a visão do Ministério da Defesa Alemão no seu desejo de estimular a alteração do modelo de negócios para os fornecedores de soluções de defesa, levando-os a fornecer versões militares de produtos de tecnologia de ponta existentes no mercado civil, por uma fração dos custos atuais e de forma mais rápida do que no passado.

Como é possível perceber até este momento, o AICOS opera numa área que oferece oportunidades significativas e diversificadas. Por isso, acreditamos que durante o ano de 2013 seremos capazes de prosseguir com o nosso desenvolvimento rumo à plena implementação do Modelo Fraunhofer.

<sup>4</sup> À altura da redação deste relatório, foi-nos comunicada a decisão oficial de aprovação de ambos os centros de competência



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# **REVIEW OF FRAUNHOFER PORTUGAL RESEARCH**

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**STRATEGIC RESEARCH AGENDA**

**PROJECTS AND RESULTS 2012**

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# STRATEGIC RESEARCH AGENDA

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GIVEN THAT FRAUNHOFER PORTUGAL CURRENTLY ONLY OPERATES ONE RESEARCH CENTER (FRAUNHOFER AICOS), ITS STRATEGIC RESEARCH AGENDA IS DICTATED BY FRAUNHOFER AICOS INTERESTS AND ACTIVITIES.

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## Business Fields

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Fraunhofer AICOS addresses two main business fields: Ambient Assisted Living and the emerging field of Information and Communication Technologies for Development.

### Ambient Assisted Living

Ambient Assisted Living (known as AAL) includes methods, concepts, (electronic) systems, devices and services that are providing unobtrusive support for daily life, based on the context and the situation of the assisted person. The technologies applied for AAL are user-centric, i.e. oriented towards the needs and capabilities of the actual user. They are also integrated into the immediate personal environment of the user. As a consequence, the technology is adapting to the user rather than the other way around. In order to share relevant information between systems and services, technologies for AAL should ideally be based on modular and interoperable concepts.

A main driver for the development of AAL technologies is population ageing. AAL technologies can be instrumental in tackling the massively increasing cost of healthcare. Another driver is the rising number of single person households together with rising expectations towards the quality of life. AAL technologies also cater towards the increasing demand of safety and comfortable living environments, as well as the increasing demand for communication and stronger social interaction with others.

Fraunhofer AICOS intends to mainly address the needs of the ageing population, to reduce innovation barriers of forthcoming promising markets, but also to lower future social security costs. This can be achieved through the use of intelligent products and the provision of remote services, including care services that extend the time senior citizens can live in their home environment. These services will increase their autonomy and assist them in carrying out day-to-day activities.



The research and development of Ambient Assisted Living solutions by Fraunhofer AICOS aims at a primary target user group, the Ageing and Elderly, with the purpose of:

- Extending the time people can live in their preferred environment by increasing their autonomy, self-confidence and mobility;
- Maintaining health and functional capability of the elderly individuals;
- Promoting a better and healthier lifestyle for individuals at risk;
- Enhancing security, to prevent social isolation and to help maintain the multifunctional network around the individual;
- Supporting caretakers, families and care organizations;
- Increasing the efficiency and productivity of resources used in ageing societies.

### Information and Communication Technologies for Development

Information and Communication Technologies for Development (ICT4D) is a general term used to refer to the application of Information and Communication Technologies (ICTs) within the field of socioeconomic development or international development. ICT4D focuses on directly applying information technology approaches to poverty reduction.

Fraunhofer AICOS intends to focus its ICT4D activities on the African continent, specifically on Mozambique and Angola. The primary target user group will be ICT users in rural and developing areas, and the objective is to provide solutions for mobile device services and applications matching the local users' demands and contributing to a more positive user experience which, in many cases, may be their first contact with ICT.

One of the most dominant differences between ICT usage in industrial and developing countries is the type of devices and technologies used when interacting with ICT. In industrial countries, interaction with ICT is made primarily via PC's, while in developing countries the mobile phone took over the role as the primary device of access and interaction with ICT.

Mobile devices, like smart(er)-phones and Mobile Internet Devices will continue to play a dominant role in developing countries in terms of growing widespread usage. In developed countries, the same tendency occurs, although the current use of PC's potentially slows down this trend when compared to developing countries.

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#### Business Sub-Fields

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Due to the large amount of topics related to both fields, and our comparably small R&D team, we have chosen to focus on fewer subfields that our customers consider relevant and which, over the first period of operation, we were able to create, taking into account our core competences that clearly differentiate us from other competitors.

In the AAL business field we are currently covering the following subfields:

##### Fall and Activity Monitoring

For frail and elderly individuals, falling can have serious consequences including injury, psychological damage, limitations on mobility and reduced quality of life. Technology addresses this issue following two different perspectives: providing a better emergency response after a fall has occurred or allowing for detection and prevention of falls, through continuous monitoring of senior adult activity. Despite the market potential, current technological solutions are cumbersome and are not inclusive as they focus on formal caregivers which present cost obstacles and are, in general, hard to handle and maintain. The Fraunhofer Portugal AICOS approach to fall prevention, detection and activity monitoring focuses on the development of solutions for smartphones which have several clear advantages: cost effectiveness, user friendliness and inherently manageable.

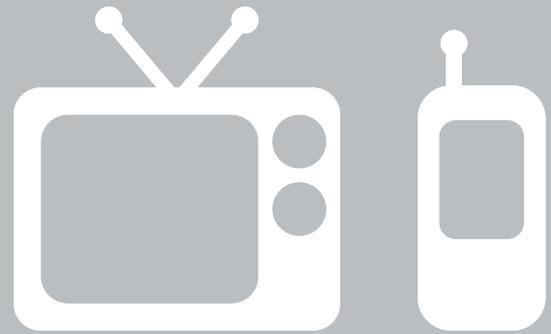
##### Chronic Diseases and Well-Being Management

Along with an ageing population comes the higher incidence of different chronic diseases. In high-income countries, chronic disease is the greatest cause of early death and disability and also a major source of costs for Social Security systems. Fraunhofer AICOS partners with relevant entities (companies, health care providers, public entities, etc.) in an attempt to help Society in improving the services for chronic disease management, by creating valid prototypes and contributing to the standardization effort through several different solutions that exist or will exist.

##### Assistive Environments

As the world's population is ageing, there is an increasing need to support independent living conditions for elderly individuals. Assistive environments incorporate the latest pervasive and ubiquitous technologies and provide a viable alternative to traditional assistive living. One of the aims is to enhance the comfort of the user. Comfort can be an essential or fundamental benefit for people with disabilities or elderly individuals. Environments equipped with these solutions have the ability to compensate some disabilities of the senior users. It can simplify their daily lives and reduce their dependency on other people by taking advantage of the functionality of the environment by themselves, reinforcing their independence and personal freedom and allowing them to remain in their usual surroundings for longer. The Fraunhofer AICOS approach is to simulate assistive environments as closely as possible by taking advantage of its recently created Living Lab and to create applications that enable the consolidation of this vision.

## ADAPTING INTERACTION TO SPECIFIC USER NEEDS



With regards to the emerging ICT4D business field, one subfield has currently been defined:

### ICT4D on Mobile Devices

The above mentioned subfield consists in mobile ICT solutions jointly developed with African partners for user groups in rural and developing areas in order to enhance the living standards of those groups. In the beginning, the solutions will target four application areas which were identified as the most market relevant in the next years: agricultural production chains, micro-enterprises, mobile health (mHealth) and mobile government (mGovernment).

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### Core Competences

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The Fraunhofer AICOS core competences are strongly related to the demands of our customers in the above described business fields. Some competences have been specifically created on demand of a specific customer, but the vast majority is related to our prediction of a future demand on the side of our customers. In order to gain competences, we are using internal projects that have ideally led to existing results and competences when a customer requires them. In this case, we can successfully transfer an internal project into an external industry project. In other cases, we are able to convince customers with results from internal projects that do not yet completely match the requirements of our competence to achieve the desired result on time and with high quality. Thus, the selection process for internal projects is very important, as any competence that we create and which is not used afterwards within a reasonable time needs to be considered as holding academic value and as an investment without return.

To date, Fraunhofer AICOS has developed the following core competences:

### Human-Computer Interaction (HCI)

At Fraunhofer AICOS, designing products and services that are adapted to our specific target audiences and that meet their needs is a main goal to be addressed. The HCI team is responsible for performing user research, designing solutions according to its results and iterating them through evaluations with both experts and final users. As such, the group is expected to ensure the significance and usability of any solution developed at the institute. The research performed within the HCI core competence is focused on the following subfields:

- User & Social Experience, associated with research on users' characteristics as well as their environments and context. It provides the knowledge needed to create meaningful solutions that meet users' demands;
- Mobile & Future Devices, a research field that includes the exploration of new technologies with the goal of enhancing users' interaction with current and novel systems;
- Evaluation & Usability, focused on evaluating the extent to which developed solutions fit users' expectations. It includes systematic evaluation tests with both HCI professionals and end-users.

FROM RAW DATA...  
TO MEANINGFUL  
INFORMATION



**Information Processing (IP)**

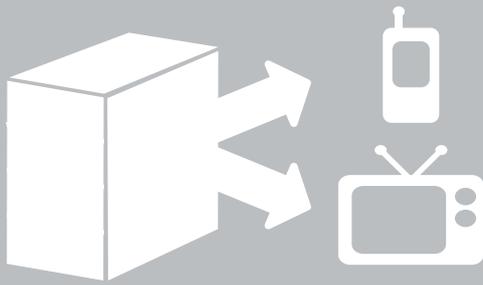
This core competence has originated from the demands imposed by our business fields and provides us with the capability to generate algorithms to solve the problems that arise in our projects. Advances in information and communication technology have triggered an exponential growth in the amount of data available. IP scientific area is related with the methods developed to cope with these vast amounts of information ranging from simple sensor events, over natural language to complex multimedia content. The IP core competence has been divided, according to our main activities, into three main subfields:

- Content Retrieval, a research field concerned with the search of information within multiple contexts. It is mainly related with the development of algorithms to extract and process the data retrieved from the different sources available;
- Context Awareness, focused on the development of ubiquitous solutions that use unconventional sensor data and combine it with environmental context information, such as the users' location or even meteorological and other geographical information;
- Multimodal Information Fusion, concerned with the combination of the information retrieved by different sources. It is mainly applied in Fraunhofer AICOS to fuse the information retrieved by different sensors in order to replace external sensors by SW for smartphones.

**Autonomic Computing (AC)**

Fraunhofer AICOS aims to create solutions adapted to people's needs and competences. However, the variety of communication technologies, Operating Systems (OSes) and networked devices creates complexity in the daily life of non-technical people. The AC core competence addresses the aforementioned complexity by proposing solutions capable of adapting to time changing conditions while hiding the intrinsic complexity from the non-technical people. Moreover, due to the specific requirements of Fraunhofer AICOS' business fields, there was the need to focus on one specific AC subfield:

- Remote Management, Control and Configuration, a research field consisting of reusing and extending remote management protocols and service discovery standards as well as implementing modular and adaptive SW architectures. It is mainly applied in Fraunhofer AICOS to cope with the lack of interoperability between devices and applications and the reduced remote management capabilities in AAL and ICT4D.



## SMARTER MACHINES: LESS CONFIGURATION & MAINTENANCE

As a consequence of the works we carried out in the business subfield "Fall and Activity Monitoring" related to the very interesting achievements regarding the related competences in "Multimodal Information Fusion", we decided to increase our activities in order to prepare for the predicted market demand through the creation of a Fall Competence Centre (FCC). The FCC will concentrate our efforts and extend the scope to go beyond the current focus on fall detection and fall risk prediction to the two additional application fields of falls in extreme sports and incident detection for security and safety personnel. Likewise, we are planning to extend our activities in the emerging business field ICT4D through the creation of the ICT4D Competence Centre, which will concentrate all the competences needed to develop and assess solutions for mobile devices in the application fields of mAgriculture, mHealth, mGovernment light and business solutions for the growing micro-enterprises in developing countries. It will also allow us to form an international team with guests from Africa and Europe that will have the potential of creating a joint melting pot for the related activities of Fraunhofer in Germany.

# PROJECTS AND RESULTS 2012

## EXTERNAL PROJECTS

### AAL4ALL

Description: The goal of the AAL4ALL project is the mobilization of an industrial ecosystem of products and services within the scope of AAL, focused on the definition of specific standards. Only by assuring interoperability between products and services is the mitigation of investment risk possible in this emerging area, thus creating a better offer of products and services.

Partners: HCP; Critical Health; Exatronic; INOVAMAIS; INTELLICARE - Intelligent Sensing in Healthcare; Meticube; CRIAVISION; PLUX - Engenharia de Biosensores; PROCESS. NET - Sistemas de Informação; OPTIMUS Comunicações; Conforto em Casa; Be Artis – Conceção; Glintt HS - Healthcare Solutions; PT Prime; Casa de Saúde de Guimarães; INESC Porto; ISEP; Universidade do Minho; ISCTE; CCG/ZGDV; INOV, UBI - Universidade da Beira Interior, FCT-UNL, Universidade do Porto - Faculdade de Engenharia, Universidade de Aveiro, Escola Superior de Educação de Paula Frassinetti, CeNTITVC - Centro de Nanotecnologia e Materiais Técnicos, Funcionais e Inteligentes Centi; CITEVE - Centro Tecnológico das Indústrias Têxteis e do Vestuário de Portugal.

Outcome: Definition of reference models for different environments that will reduce the investment risk and time-to-market of the products and services and establish solid partnerships with the national industry.

### eCAALYX 1

Description: The eCAALYX project is an AAL system that enables remote monitoring of the health condition of elders with chronic conditions at home and on the move. Fraunhofer AICOS' main focus is on the aspects of remote management and auto-configuration of the system as well as the system user interface and interaction.

Partners: TeleMedic Systems, Fundació Privada CETEMMSA, Telefonica Investigacion y Desarrollo, Corscience, Fundació Hospital Comarcal Sant Antoni Abat, University of Limerick, Zentrum für Kardiovaskuläre Telemedizin, National University of Ireland, Galway, University of Plymouth, INESC Porto.

Outcome: Fraunhofer AICOS has developed an intuitive personal health channel available through the set-top-box where patients are able to follow their condition, receive medication reminders and perform video calls. AICOS has also defined a TR-069 extension which allows the home gateway to collect data from the medical sensors, pre-process measurements and raise alerts on the caretaker server.



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## REMPARK 2

Description: The specific and ultimate goal of the REMPARK project is to develop a Personal Health System (PHS) with closed loop detection, response and treatment capabilities for management of Parkinson's disease (PD) patients at two levels. At the first level, the project will develop a wearable monitoring system capable of identifying the motor status of the PD patients in real time. At a second level, the intelligent analysis of data provided by the first level, supported with a disease management system, will allow the neurologist to decide about the treatment that best suits the patient.

Partners: Universitat Politècnica de Catalunya, National University Ireland Galway, Centro Médico Teknon, Fondazione Santa Lucia, Maccabi Health Care, Telefónica I+D, M&M Qualtech Ltd., Mobile Solutions Group.

Outcome: Specification and development of a mobile gateway communication service for interconnection of the sensors and actuators. Smartphone user interface development for management of Parkinson's disease.

## S4S - Smartphones for Seniors

Description: The project will enable senior users to quickly master common smartphone features, through user interfaces and navigation patterns tailored to meet this group's specific needs, as well as to easily interact with more specific features purposely-built for them, e.g. receiving medication reminders or allowing their health status to be monitored.

Partners: Microsoft, DEVSCOPE - Soluções de Sistemas e Tecnologias de Informação, OPTIMUS - Comunicações, WIT SW - Consultoria e SW para a Internet Móvel, Faculdade de Ciências da Universidade de Lisboa, Universidade de Aveiro.

Outcome: Development of applications for the Windows Phone environment in the areas of health/wellbeing and leisure/recreation.

## SavEnergy - Energy Efficient Base Stations

Description: The overall project objective is to investigate and develop new solutions for energy optimization of antenna installations, incorporating the following aspects: increase of energy efficiency, use of equipment with lower energy consumption, promotion of the use of renewable energies and monitoring of energy consumption taking into account environmental and other conditions, in order to devise the best strategies for the operation of micro-generation solutions.

Partners: Be Towering (Optimus), EFACEC.

Outcome: Optimization of energy in cellular antenna installations. Fraunhofer AICOS reuses the remote management platform developed in eCAALYX and reapplies it to a completely new environment.

### E-No Falls

Description: The main goal of the E-NO FALLS Thematic Network is to integrate and bring together knowledge, experiences and best practices acquired at the European and international level in the area of fall prevention, intervention and safety, with the purpose of coordinating on-going activities and creating the necessary conditions and consensus on action plans, standards and specifications to ensure the widest future replication and co-deployment of innovative solutions (with special emphasis on ICT-based ones).

Partners: Tunstall, Siveco, Universidad Politécnica de Cataluña, Fraunhofer AICOS, University of Limerik, Coos March Onlus, Stichting Smart Homes, Nordforce Technology AB, Fondazione Santa Lucia, TicSALUT, Forth Institute of Computer Science, NUIG, CETEMMSA, Ana Aslan International Foundation.

Outcome: The E-NO FALLS thematic network will be a forum for all stakeholders within the value chain (such as industry, user organizations, formal and informal care providers, public authorities, investors, housing and insurance companies and service providers across Europe) to share knowledge, expertise, resources, best practice experiences and to build consensus to highlight the remaining obstacles to be overcome and to eventually provide guidance for ICT-enabled solutions and their roll-out.

### ChefMySelf

Description: The main goal of the ChefMySelf project is to develop a customizable, open and extensible (ICT) service ecosystem built around an automatic cooking solution to support elderly people in the preparation of meals and maintenance of healthy eating habits. A food processor with an accessible interface, specially tailored for the elderly, will encourage them to self-care, according to their particular

nutrition requirements. Simultaneously, a social network, focused on the topic of healthy aging and eating, will become a motivational tool to remain active, while encouraging existing social relationships and the cultivation of new ones. The target groups for the AAL-solution proposal are independent senior individuals with no severe illnesses or disabilities, but not excluding those with some type of mobility or mild cognitive impairment.

Partners: Fundació Privada Cetemmsa, Istituto Nazionale di Riposo e Cura per Anziani, Polne SL (Taurus Group), Unie KBO, ASM Market Research and Analysis Centre, Me.Te.Da.

Outcome: The envisioned ChefMySelf system can be divided into three main components – Cloud Services, User Interface and Food Processor – each interacting with the others over a set of secure, open and standardized interfaces. The proposed system will follow the cloud computing paradigm, ensuring security, scalability and reliability.

### SMARTSKINS

Description: This project aims to design and effectively develop and implement a framework of risk triage of skin cancer, which uses a new generation of mobile devices in its architecture to capture the images. The framework is going to automatically pre-process and segment mobile-acquired skin moles images, as well as perform image registration and extraction of significant features for risk assessment and melanoma pre-diagnosis purposes. The automatic risk assessment will be based on machine learning methods using extracted features, cross-correlation analysis, additional information available submitted by the patient and an adaptive reference atlas of classified skin lesions. The images that make up the reference atlas are previously classified by dermatologists and are used to provide a highly reliable triage of lesions based on images acquired by low cost devices such as smartphones.

Partners: IPO-Porto, INEGI-LAETA.

Outcome: The key factor for the successful development, implementation and validation of this mobile-based risk triage framework is the active involvement of an online community of dermatology specialists, who are consulted whenever a warning sign is automatically detected or the automatic diagnosis is below the desired confidence level. The contribution of the specialist community is also used to generate supervised data that is subsequently added to the reference atlas, which turns the framework into an adaptable tool that continuously “learns” with the dermatologist community.

#### **EnAware – Domestic Energy Awareness**

Description: The raising costs of energy and the increasing consumer awareness with regards to their ecological footprint poses new challenges to industry. Especially in a domestic context, consumers demand energy efficient products and solutions that integrate seamlessly and which are easy to use. Moreover the slow, but steady, introduction of the SmartGrid requires more intelligent domestic devices to enable Demand Side Management / Demand Response scenarios. The EnAware project addresses these challenges by developing an ecosystem of smart devices that are orchestrated by a so called home server. By allying the capabilities of the Advanced Metering Infrastructure (AMI) with Home Automation and domestic Intelligent Electronic Devices (IEDs), this project aims to innovate the way in which residential consumption data is presented and analyzed in order to improve user comfort but at the same time motivate sustainable changes of behavior.

Partners: Bosch Termotecnologia, Efacec, Efapel.

Outcome: Integration of the whole energy provisioning and domotic control eco-system to give useful information to the end customer/user. The users will be empowered with a personalized interface that will allow them to control all smart devices in real time and to review their energy consumption habits.

#### **Game Foundry**

Description: The main goals of this project are the implementation of a new platform for knowledge management and monitoring of human behaviour based on the use of network games. It is intended to give the users the possibility to play games in different environments and on different platforms. Also, it allows publishers to independently create a set of games with proprietary contents, accessible over the network, supplying each of them on all supported platforms: web, mobile, Facebook, Google+ and TV. A data warehouse will be set up to store all gaming data and on which new data-mining and statistics algorithms will be applied to provide useful and meaningful data to the publishers, becoming a useful decision making support tool for marketing actions.

Partner: Ubbin Labs.

Outcome: New data-mining algorithms for the extraction of information and automatic pattern recognition of the gaming experience for the characterization and classification of users based on content, location, age, etc.



### GRA ICT4D

Description: The GRA ICT4D project runs under the auspices of the GRA (Global Research Alliance), an international organization promoting the application of science and technology to solve large scale issues in developing countries. The goal is to develop a green and low-cost wireless communication network and mobile applications for rural Zambia. Fraunhofer AICOS contributes with mobile SW solutions which will be piloted on top of the developed communication infrastructure.

Partners: Fraunhofer Germany FOKUS, VTT, CSIRO, the Meraka Institute and the Zambian NGO MachaWorks.

Outcome: GRA ICT4D will further refine Fraunhofer AICOS' ICT4D strategy as it follows AICOS' A4D approach. Pre-commercial SW toolkits for mobile devices will be developed to support the acquisition of external projects in the future, e.g. the project will use and further extend PostboxWeb.

## INTERNAL PROJECTS

In order to foster core competence building and to enhance our team's experience, we frequently assess ideas and launch internal project initiatives.

### Mover & Fall Prediction 3

Description: Falls are dangerous, prevalent and costly. The falling rates are considerably higher among elderly, and are one of the major obstacles to their ability to live independently. The projection of an ageing population poses a severe burden to the health services; the financial exertion and physical requirements needed to provide the current level of care to such a large projected population are far too great to be feasible. Various ideas need to be produced by taking advantage of current technologies, allowing senior individuals to remain at home and live a normal and safe life. Several falling risk factors were identified and specific interventions were designed in order to reduce such risks. However, they are only applied with low frequency, requiring experts and expensive equipment. The goal of this project is the development of a market ready solution for the detection and the early prevention of falls using a smartphone as the main platform. The development of a record of the results, accessible both to users and doctors, and the development of real world trials targeted at specific groups of users are also objectives of this solution, which will be able to serve hundreds of millions of users in their daily life.

Outcome: A new algorithm for fall risk analysis and fall detection implemented on a smartphone and validated through a real world trial.



4

#### User Network 4

Description: The User Network aggregates a number of institutions, such as adult day-care centres or nursing homes, which provide Fraunhofer AICOS with access to senior users, as well as to caregivers, such as older adults' relatives, geriatricians or nurses (secondary users). These users will enable AICOS to better understand older adults' needs and characteristics and to thoroughly evaluate the user interfaces designed for them.

Outcome: Currently, the User Network aggregates nineteen institutions and includes senior universities, adult day-care centres, living centres and healthcare institutions.

#### Melanoma Detection 5

Description: A smartphone application that uses the built-in smartphone camera and allows the user to analyse skin moles through digital image processing techniques, based on the extraction of four visual features highly relevant for the early detection of malignant melanoma. The application provides a visual feedback of the analysis of each feature in real time, and a report analysis is saved on the smartphone. The validation of the prototype will be done by means of a supervised classification of the images, which is based on a dataset of images of skin lesions previously classified by medical specialists from the Dermatology Department of the Portuguese Institute of Oncology of Porto.

Outcome: Creation of a prototype for a patient-oriented system of skin lesion analysis using a smartphone. The prototype aims to implement a self-monitoring system that collects, processes, and stores information of skin lesions through its automatic classification system.



5

#### FUSAMI

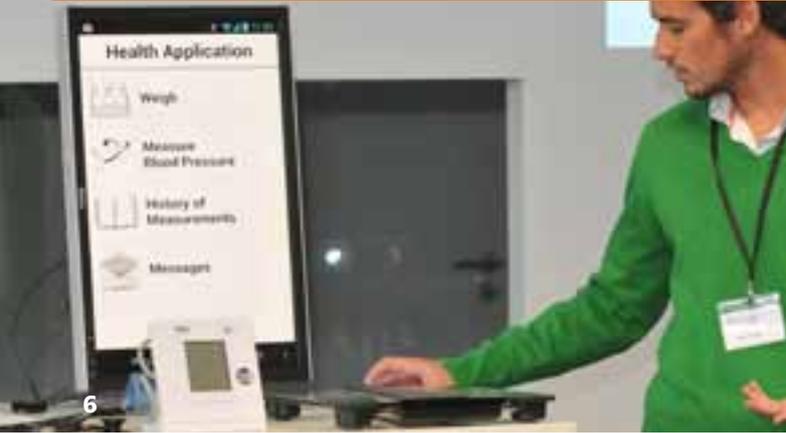
Description: The Fraunhofer Usage Mining (FUSAMI) system offers smartphone developers and HCI specialists a cloud platform to perform advanced analytics on real-time usage data. The system helps developers to get a better insight into the user's interaction and to unveil usability issues. The system observes the user interaction in a real application and applies state of the art analytical algorithms to find and visualize the hidden patterns in the user interaction. Thus, FUSAMI draws attention to possible design issues which could have negative impact on the User Experience (UX).

Outcome: The FUSAMI system can be easily integrated into nearly any existing Android application through a simple API. Similarly, an Eclipse plugin was developed which integrates the FUSAMI API automatically, and submits the screenshots to the FUSAMI platform.

#### Smart Companion

Description: The Smart Companion makes it simple for inexperienced users to master general mobile phone features, such as making calls and sending voice and text messages. It also enables its users to receive medication reminders and to call the emergency line from the Home screen in just one step. This project is based on the Android platform and has been specially designed to meet senior adult needs.

Outcome: Development of prototype for Android phones with a set of specific services, such as making calls and sending voice and text messages. Possibility of extending the design to new applications developed for the smartphone.



**Heart Failure Clinic 6**

Description: Heart failure is a serious condition associated with high mortality and morbidity rates. Heart failure is also one of the most expensive medical conditions to treat, mainly due to the high levels of hospitalization and readmission rates associated with these patients. Despite recent advances in therapy, heart failure patients still suffer from repeated hospitalizations which are mainly due to the progression of their disease, low commitment to diet and medical therapy and to limited access to medical care. The Heart Failure Clinic project goal is the development of a remote monitoring system which enables daily contact with healthcare experts and thus facilitates regular short-term evaluation of the disease status and early detection of decompensation signs and symptoms.

Outcome: By using a mobile application and a set of associated monitoring devices, patients are able to measure several vital signs and symptoms determined as relevant by a group of cardiologists currently collaborating with the project. The information related the patient pulse rhythm, heart rate, blood pressure, weight, bio-impedance, presence or absence of crackles and the answer to simple questionnaires with symptom related questions, is stored on the patient’s smartphone and sent to a remote server to analyse the recently measured data. This server processes the vital signs of each patient and according to pre-established rules, classifies and notifies a physician in case of need. The heart failure clinic application contributes to a timely intervention on the patient’s disease.

**AR-Glasses 7**

Description: The project is meant to prepare a demonstrator for an Augmented Reality (AR) glasses. This will include the implementation of pairing and data transfer between the MOD™ device and a smartphone, a smartphone application as well as a client and a service to handle ‘Web’ requests.

Outcome: Strengthening Fraunhofer AICOS position as provider of mobile solutions for assistive environments.

**Dance Don’t Fall (DDF)**

Description: Dance! Don’t Fall is an Android application that monitors the users’ risk of falling and simultaneously and actively reduces that risk by means of a fun activity. Being a serious game, DDF invites participants to perform a dance; that is, a series of choreographed moves. Once the dance is finished, DDF gives feedback on the users’ dancing performance and risk of falling.

Outcome: Strengthening Fraunhofer AICOS’ position as a leading research centre in fall monitoring and prevention while motivating wellbeing and social interaction.

**ULF-MC 8**

Description: Ultra Low Frequency Magnetic Field Communication (ULF-MC) consists of a wireless communication technology for smartphones, based on the generation of low-frequency varying magnetic fields. As most of the smartphones are already equipped with 3 axis hall effect sensors (i.e. electronic compasses) - capable of measuring variations in magnetic fields - these are all-set in order to communicate using the ULF-MC technology.

Outcome: ULF-MC can be used for multiple applications such as Precision Indoor Location, Location-based Services and Mobile Retail Solutions. It is currently under development at Fraunhofer AICOS, with a first prototype already available for demonstration purposes. It has also been awarded the Galileo Master prize at the European Satellite Navigation Competition, 2012 edition (highest distinction).



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## ACADEMIC ACTIVITIES

Regarding academic activities, it is worth highlighting that the Director of Fraunhofer Portugal AICOS is an invited Professor at the Faculty of Engineering of the University of Porto and AICOS is responsible for proposing a set of topics for MSc theses. The MSc students join the team to work on applied research projects and also in their own thesis. The topics proposed for theses are aligned with the Strategic Research Agenda defined by the scientific board of Fraunhofer Portugal.

### Data Mining and Visualization of Android usage data

The evaluation of existing user interfaces is a challenging task, especially when it comes to the use of smartphone applications. It is particularly hard to identify frequent tasks performed by the users, given that many tasks are of a non-sequential nature and can be manifested and ordered in different event sequences. Designed as an add-on project to FUSAMI, the “Data Mining and Visualization of Android usage data” (DAVE) project explored the application of the Latent Dirichlet Allocation (LDA) algorithm to the domain of usage data. It was possible to demonstrate that the algorithm, although being originated in the domain of Natural Language Processing, is capable of capturing the latent non-sequential task models hidden in the click streams of a prototypical Android application. In the scope of the project, the visualization of non-sequential tasks was also investigated through the use of heat maps. The LDA algorithm is a suitable algorithm to detect latent non-sequential tasks and the discovered task models might give additional insight to HCI specialists targeting the improvement of an existing smartphone application.

### Information Extraction from Medication Leaflets

With the constant growth of electronic medical systems, including decision support systems and personal wellbeing applications, the need for understandable machine information has increased. However, much of the data currently available is in free-form text, which is a convenient way to express concepts and events, but is especially challenging for machines to process. Information extraction can relieve some of the problems related to processing free-form text by providing a semantic interpretation and abstraction of texts. This thesis presents the PharmInX information extraction system, which aims at automatically extracting information from pharmacological texts, especially from medication leaflets. The system was designed to target different types of information regarding pharmacological products, particularly their posology, side effects and indications. The primary goal is to provide high-quality and machine understandable information, which is currently not available for medical electronic systems. Making this information available, these systems could provide better care services to patients, and enhance decision support systems for healthcare professionals. The PharmInX system was designed and developed with these goals in mind. It includes six components, each of which has different capabilities: 1) text pre-processing, 2) document reader, 3) general natural language processing, 4) named entity recognition, 5) relation extraction and finally 6) consumer information. The interpretation of these components relies on rules, regular expressions, searches in external resources and machine learning. Once all these stages are completed, we can then access the information extracted through an ontology which was carefully developed to support the pharmacological information intended for extraction. For the purpose of both development support and evaluation of the system, some pharmacological documents were manually annotated and used as gold standard. The results achieved by the system by resorting to this evaluation indicate that pharmacological and clinical information can successfully be



extracted from free-form texts in Portuguese, presenting an F1 score of 99,23% when recognizing entities and a F1 score of 97,43% when extracting relations between those entities.

### Adapting Mobile Devices for Seniors' Usage - an Automatic Management Approach

With the growth of the ageing population, smartphones are becoming a relevant tool in the fight against social isolation among the elderly population. However, smartphone services and application parameters are difficult to configure, especially by the less experienced users, such as senior adults. The usage of remote management protocols allows mobile operators to provide configuration parameters for those applications and services without the need of any user interaction. However, remote management protocols are still not widely adopted by mobile operators, who usually implement proprietary solutions with high operational costs. The goal of this project was to develop a remote management solution using open and well established remote management protocols, which are capable of managing application data and configuration on Windows Phone 7 (WP7) devices. The solution developed uses the Open Mobile Alliance Device Management (OMA DM) protocol to manage application data on mobile devices and is composed of three main components: Remote Management Server, Remote Management Library and Administration Interface. The Remote Management Server follows OMA DM specifications and is the entity responsible for managing application data in mobile devices. The Remote Management Library synchronizes application data with remote management servers following OMA DM specifications. The Administration Interface allows system administrators to manage synchronized application data, as well as user credentials and devices. The final product of this project is a remote management solution using open remote management standards, capable of managing WP7 application configuration parameters and data, in a seamless way to the user. This document presents the technologies

and protocols used in this project, as well as the design and implementation details. The developed components were tested in order to evaluate the overall solution and to propose possible improvements.

### User Interface Design Recommendations for Fitting Smartphone Applications to Persons with Parkinson 9

This thesis arises from the need to adapt one of the latest technological tools to individuals with Parkinson. Previous research has explored how to adapt some technological devices to this group of individuals. However, little has been done to adapt touch interfaces and much less to explore the potential of smartphones. Here we document the research done in order to study the impact of Parkinson's Disease (PD) on the interaction with a smartphone, and also present a set of recommendations to adapt the smartphone to individuals with Parkinson. The research carried out in the first stage was a user-centred design (UCD) process. It started with the review of the literature focusing on the symptoms of PD, followed by a series of interviews to collate more practical information about the actual effects of PD symptoms on people's lives and ended with four usability experiments in order to test the assumptions made in the earlier phases about how PD would affect the use of the smartphone. Moreover, the interviews were analysed using an innovative methodology in Human-Computer Interaction (HCI), namely the Grounded Theory. Although this methodology originated from social sciences over 40 years ago, it was only a few years ago that it began to be an adopted practice in HCI. The usability experiments were designed in an attractive game-like layout and benefitted from an automated analysis. This work was done within the scope of the REMPARK project, a European-funded project to develop a smartphone-based Personal Health System with detection, response and treatment capabilities for the management of PD.



### Rich VoiceXML Browser and Voice- and Mobile Web based CMS

The "Rich VoiceXML Browser and Voice- and Mobile Web based CMS" project, developed throughout five months, aimed to allow individual telephone subscribers to have an experience in all similar to browsing the Web, enabling them to create and offer voice-based services and customized data. At the core of the proposed system is the design of a generic voice-based browser for voice content, with similar features to those that exist for the Web, e.g. bookmarking, history, personalization. Together with the voice browser, we implemented a basic content management system (CMS) that allows for the easy creation of voice content through a voice-driven interface. These two components, associated with a supporting infrastructure, allows voice-based applications to be created and housed in a hosting platform on the network, available to other subscribers. The technological basis selected for this project was Java and the logical architecture was divided into three blocks: 1) the Browser Core component, which enables the interpretation of voiceXML content, recognition and synthesis of dialogue, as well as the interpretation of JavaScript; 2) the Rich User Interface component, which allows for personalized browsing through voice applications, in all similar to browsing the Web, providing bookmarking functionalities, history management, and session resume support; 3) the basic voice-based Content Management System component, which offers the possibility of creating voiceXML and HTML content through a voice interface. The Java (J2SE 1.6.0 framework), JavaScript and Servlets technologies were used to develop this project. Finally, the data layer is supported by MySQL technology and the Integrated Development Environment (IDE) chosen was Eclipse.

### Phone Based Sit-Stand-Sit Movement Analysis

This project defends the use of the smartphone as a measurement instrument for the Sit-Stand-Sit movement, as it is a prerequisite for walking and of paramount importance for the analysis of fall risk. By using the smartphone's accelerometer and gyroscope sensors, an algorithm was built in order to analyse key features associated with the movement. Two tests for fall risk evaluation were implemented: the 5 times sit-stand-sit test and the 30 seconds sit-to-stand test. To validate the algorithm, 20 young adults and 15 senior adults performed both tests, which resulted in a total of 150 test recordings. These recordings were also filmed in video to compare the features returned by the algorithm with those extracted from the videos. Transitional movements were correctly identified with a precision of 99.3%, with an average difference of 0.311 seconds in the total duration of the tests and 1.8 degrees of error in the trunk tilt. There was also a clear distinction in the number of repetitions performed between young and older adults in the 30 second sit-to-stand test as reported in the literature. Results suggest that the smartphone can be used as a major strategy to improve fall prevention; their popularity is likely to continuously increase in the near future due to the fall in prices, allowing more people to access the product and bringing added value to the life of senior individuals.

### PostboxWeb – An Offline-Capable Framework for Web Data Storage and Sync for Shared Devices 10

In recent years, mobile devices in developing countries have seen a great increase in the number of users. Many telecommunication companies are competing for a place in the growing market by providing useful services to end users. The number of the mobile device users is growing so quickly that some defend that these countries will not experience a personal computer (PC) era, but rather they satisfy all their needs through smartphones and like devices. Many people have adopted mobile phones for daily tasks, ranging from

basic communication with relatives to small family business support, either for communicating with clients or receiving service requests. The fact is that, despite this “mobile boom” in developing countries, there are many locations where there is no network coverage and therefore users do not benefit from the services offered in the cloud. In an attempt to mitigate this situation, this master’s thesis project has the purpose of designing and implementing a base version application programming interface (API) to enable data-heavy Internet services in disconnected areas. The solution consists in creating a multi user capable Android mobile device. Each user’s data is stored in an encrypted manner on the device using a ciphering key. The user may interact normally with applications that require internet connection, with the exception that all the requested and posted information will be synchronized as soon as there is a network connection available. The framework to be developed should be data independent considering that it aims at developing an end user application connected to almost any type of service, as long as it complies with Representational State Transfer (REST) design principles. This solution should allow wider access to information among the developing world population. During the analysis of Android system, we concluded that this solution is feasible. A base version of the solution that was developed and which is described in this thesis ensures the intended functionality. Tests were carried out according to different evaluation parameters and the results revealed small overhead when compared to a custom implementation for a specific application. We therefore conclude that our solution design is feasible and can be applied in a real scenario. The possibilities of integrating the solution in wider projects to support a better information distribution model are also considered and analysed as a part of future development goals for this project.

### **Run-time Management of Energy Efficiency on Industrial Scenarios - An Autonomic Computing Approach**

Reducing energy consumption by the infrastructure of the Communications Service Providers (CSPs) is currently one of the critical factors driving advances in telecommunication technologies. Improving the energy efficiency of telecommunication networks is a significant contribution towards a “greener” environment, strongly pushing organizations towards the implementation of sustainability strategies and encouraging governments to develop incentives for “environmentally friendly” actions. Additionally, the increasing weight of energy expenses in operational costs for the industry and service sectors turns the adoption of the aforementioned actions into a cost saving opportunity. With the objective of decreasing the power consumption and integrating innovative solutions, such as renewable energy sources, within a Base Transceiver Station (BTS) site, this MSc thesis aims to present an energy management mechanism based on the Autonomic Computing (AC) philosophy. This solution interfaces with several BTS site components (e.g. AC, renewable energy sources, batteries, etc.), handles the collection and management of their energy consumption data, and the integrated management of their operation. These monitoring and management functionalities are processed according to medium-to-high level energy efficiency policies (e.g. “Activate energy supply via utility if solar radiation drops below  $X \text{ W/m}^2$ ”) created by the system administrator. The system’s architecture is composed of two main blocks: the BTS Site environment and a remote central server. They are separated entities that use the Internet as their communication route. The Central Server is responsible for supporting the BTS Site Environment, providing them with additional services. The BTS Site environment is the “heart” of the system and where the intervention focus of this thesis will lie. It is made up of an “Energy Box”, which is the element responsible for managing the set of sensors and actuators running at the BTS Site, which in turn are responsible for the management and control of certain variables



related to the BTS Site. This document introduces the areas involved in the development of the aforementioned system and specifies its application scenario. An architectural specification for the system is proposed and the implementation steps are explained during the development of the system's proof-of-concept within the light of the main objectives defined. To assess if the system is operational and aligned with the main objectives presented, a system evaluation is also performed leveraging the feasibility of integrating the system into a real BTS Site environment. The final system output fulfills the base requirements presented, providing a modular architecture to an autonomous system to be deployed in a BTS Site.

### ANT+ Medical Health Kit for Older Adults

Rising life expectancy and declining birth rates are responsible for the growing ageing population in most developed countries throughout the world. As a result, in a few years, the percentage of senior citizens in our society will be quite high; therefore, it is more important than ever to unveil forms of improving their well-being and quality of life. Unfortunately, senior adults require healthcare services more than other adults, which means they require frequent monitoring by their doctor. Most of the time, the measurement of a few values is enough, but the patient is forced to make long trips to the hospital or to pay expensive medical appointments, which in the end, leads the elderly to not undergo the appropriate treatment. In addition to this, if a problem is not detected on time, serious problems can arise, resulting in a longer and more difficult treatment. Recent improvements in sensor technology, specifically on the ANT+, have made it possible for the device to operate for more than one year on a small battery. This technology can be compared to Bluetooth 4.0, designed for the collection and transfer of sensor data. These sensors can be used with several devices — heart rate monitors, speed sensors, blood pressure monitors, foot pods, among others —, but their standalone use is quite limited. However, combining those sensors with a smartphone

creates an independent solution that, without any more requirements, has an enormous potential. The advanced computing power and connectivity features available on a standard smart-phone, allow for an almost endless number of possibilities, whereas current applications are only scratching the surface. This thesis describes the research done on current mobile health monitoring systems, targeting the elderly and the development of an elderly-oriented solution, standing as a proof-of-concept of the research carried out. This work provides two scientific contributions by specifying a system with components and characteristics that were never combined before, when applied to the health monitoring of older adults; and by developing a prototype for this system and evaluating its success with end users, namely the elderly. The proof of concept solution allows the patient to measure themselves with ANT+ sensors connected to their Android smart-phone. The measured data is stored on the mobile device for future reading and sent through the network, to a medical entity. This entity can, analyse that information at any time and provide appropriate feedback to the patient through a web application.

### PHAR – Android Augmented Reality Using a Handheld Projector 11

The Projective Handheld Augmented Reality (PHAR) framework provides an Android developer with high-level tools to create augmented reality applications which use a handheld projector as a display. Typical mobile augmented reality applications display their graphics through the small screen of the mobile device. This poses a few problems: certain user groups, such as senior individuals, might have difficulties reading the information displayed on the screen, due to the size of the letter type. The display quickly gets cluttered with information, making it difficult for any user to read instructions. Furthermore, users get too focused on the screen, in all similar to SMS reading, and lose track of their surroundings. A solution for the above stated problems is the



use of a pico-projector to display the graphics. These small projectors, roughly the size of a smartphone, are capable of displaying images which, in theory, might have diagonal sizes of 160 centimeters or more. Besides the advantages of this larger size, with more room to display information, the graphics are projected directly into real-world objects avoiding the distraction of augmentations through the device's screen. The PHAR framework was created for this purpose, facilitating the development of mobile augmented reality applications by using a handheld projector. PHAR is built on an OpenCV computer vision library, and addresses two complex steps that are the basis for projector-based augmented reality (AR) applications, and which aim at simplifying the process. The first step is to detect a target object for the augmentations. PHAR has an object detection procedure which does not require physical markers, and which is commonly used in mobile AR. The only configuration required for the detection lays in providing the programme with a front image of the target object. The second main step is to automatically adjust the projection so that the augmentations are properly displayed on top of objects, while the handheld projector or Android device moves. Typically, this geometrical correction of the projection will work transparently, and does not require further action from the developer.

#### **KINTERACT – Gesture Recognition for Natural Interaction with Applications 12**

Nowadays, there are several motion sensors available on the market which can be used as a natural user interface for applications. The Kinect sensor by Microsoft is such an example. This sensor was and is mainly used for games, however the scientific community has been discovering a number of areas in which this type of devices can be of major service. Kinteract is a driver that was developed having in mind the use of gesture recognition to control any application. Due to the frequent difficulty many senior citizens reveal when interacting with new devices, and in order to promote healthy physical

movements, this project has the primary goal of integrating the Kinect sensor with a set-top box, featuring a simplified user interface, allowing the user to interact with that interface by using simple gestures instead of the usual remote control. This project can be extended with the possibility of exploring the sensor's microphone array for spoken commands, using voice as the input source. Another possible use of Kinteract lies in the promotion of physical activity through a body movement and positioning game, which can also be used for rehabilitation purposes. Kinect will be used to detect the skeletal position in order to continue with the game. In this way, there will be a strong appeal for the senior individual to move, encouraging them to safeguard their own health and well-being.

#### **Evaluation, Redesign and Implementation of a System to Support Early Dementia Contexts**

Everywhere in the world, population ageing is perceived as a double-edged sword. While it does show an incredible perseverance of the human race and its ever-growing feats, it constitutes a problem when observed from the point of view of healthcare systems and governments. The current situation of a declining economy puts an even greater strain on the difficulties that nations need to overcome. As people age, they experience changes in their perceptual, motor and cognitive systems. In these scenarios, chronic conditions are more likely to develop. Dementia is one such condition, notable for being very frequent and with a very high impact on the lives of the elderly. Alzheimer's Disease (AD) is the most common type of dementia and causes people to progressively lose their ability to live independently. Caregivers are therefore essential to help them overcome a wide variety of obstacles, but in order to do that, they too struggle psychologically, socially and financially. This dissertation focuses on the design, evaluation and development of technology to aid in contexts of dementia, namely with people with early-stage AD and their caregivers. It builds upon a previous project in which a



system called mobileWAY was partially designed and tested and not at all implemented. mobileWAY explores the concept of caregivers using a mobile application that can connect with their TV at the home, allowing them to keep watch over the impaired person. The system enables caregivers to communicate information to the dementia-affected individuals, namely who they are, their whereabouts and how long they will take to return to the home of the person suffering from AD. In this dissertation, the initial version of mobileWAY is tested again, redesigned and improved, and a working prototype is developed and tested. This project encompasses the areas of Human-Computer Interaction (HCI) and SW Engineering. During the project's development, a user-centred design (UCD) approach was followed and combined with agile methodologies to achieve the final working prototype. The project contributes with a tested system prototype that follows adequate design guidelines and best development practices. The system was systematically evaluated and makes use of state-of-the-art technologies that include an Android-powered tablet device and Google TV to provide support in contexts of dementia, which is a difficult yet increasingly important area of research.

### **Polypharmacy and falls in the elderly population**

Falls are common and a serious geriatric syndrome. The impact on the individual's quality of life and consequent disability is considerable, and multiple factors contribute to this risk. The use of a certain medication (sedative/hypnotic agents, antidepressants, neuroleptics, and psychotropic drugs) is being increasingly recognized as a factor which contributes to falls in seniors. The amount of medication used by a patient is another possible cause behind the number of falls among the elderly. Published practice guidelines contain recommendations regarding the revision, alteration or cancellation of medication in patients who have fallen, in light of the risk of future falls. They also recommend particular attention to medication reduction in elder individuals who take four or

more types of medication and for those taking psychotropic drugs. Several studies report on other drugs and drug classes which may have intended or unintended pharmacological effects which should be taken into account when prescribing treatments to patients with risk of fall. The goal is to develop a system capable of supporting, advising and alerting in situations where there may be a potentially problematic situation. Such system could be used in several applications in order to contribute, for example, to a faster and less error prone prescription system, or be used in systems capable of predicting the risk of falls in elderly people.

### **Improving pedestrian navigation for older adults with mild cognitive impairments through landmarks**

Nowadays, ageing is perceived as a global epidemic due to the rapid growth of the older population throughout the world. It is predicted that in 2050, for the first time in recorded history, the older population is set to surpass the young population. For this reason, an increase of incidence of age-related physical and mental impairments can be identified. Dementia, in particular, is a well-known syndrome which senior adults are prone to develop. This condition is connected to a progressive loss of cognitive ability, leading to a number of difficulties such as mobility problems and time and spatial disorientation. A wandering behaviour, consisting in an aimless and disoriented walk, may present itself as the most distressing symptom as it sometimes leads to accidents, injuries or even death. Such issues result in decreased navigation skills - the type of skills a person needs to find their way to a location - for example, an increased dependency on the patient's caregiver. This dissertation approaches these mobility problems and is dedicated to investigating how two distinct navigation concepts (landmark-based and turn-by-turn) affect the mobility and sense of safety of senior adults and individuals with mild dementia. This goal was pursued by developing a prototype of a pedestrian-oriented navigation application, to be used in mobile devices by the previously mentioned users.

This solution uses a landmark-based approach, introducing nearby landmarks in the generated instructions whenever considered relevant. As an alternative, the prototype also allows for the alternative turn-by-turn paradigm, currently the most common navigation method used. The prototype was used as a tool for an empirical study: 12 participants varying between 63 and 80 years of age were selected and divided into two groups to perform field experiments. The subjects were asked to use one of the two implemented navigation methods to reach an undisclosed destination. The collected data revealed that a landmark-based approach presents a relevant increase in older adult's mobility, orientation and sense of security.

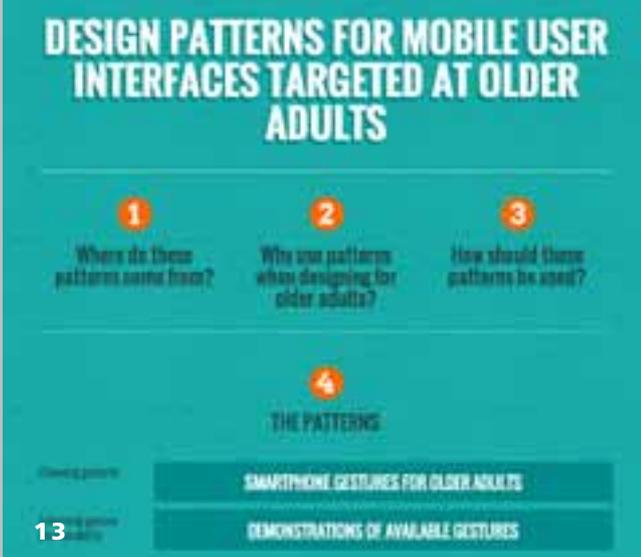
#### **Bluetooth link robustness in Body Area Networks**

This study is included in a critical healthcare monitoring system, where there is the need to assure that within a Body Area Networks (BAN), all the information coming from the devices is fully delivered on time to its destination. The communication between the different devices used in this system is established by Bluetooth. This technology uses a frequency band that is nowadays widely used by other technologies such as Wi-Fi networks, microwave ovens, cordless phones, etc. On such a busy medium, it is unavoidable that collisions will occur, leading to the delay/loss of information. In order to confirm the sturdiness of this connection, and within the context of the project, we evaluated the extent to which possible interferences could damage the link, creating delay/loss of information on these communications. For that purpose, we developed software that allowed us to test the different stages of each experience in the laboratory, recreating realistic scenarios. We tested the way in which Bluetooth communications reacted when established on a medium crowded by the transmission of several Wi-Fi devices, and also when close to an operating microwave oven. Our results show that Wi-Fi and microwave ovens interfere and affect Bluetooth communications. This can be seen by the resulting packet delay

values and by the average time of data transfers. Transferring the same file with interference took approximately twice the time it took without any source of interference. These results also show the intensive use of coexisting mechanisms and also the resilience of a Bluetooth link.

#### **Human-Computer Interaction via Brain Waves**

Brain waves show different rhythmic activities according to the individual's level of consciousness. These rhythms are captured in different areas of the cortex and are affected by different actions and thoughts. They can be grouped in order to detect brain activity patterns, and the identification of these patterns could be used to give direct commands to computers with the intention of performing specific tasks by only using our thoughts. The detection of brain wave patterns for a specific task is not straightforward due to the unique brain responses of each individual (even for the same tasks), so the system has to be previously trained for the tasks we want to detect. The training process consists in thinking about performing that specific task and detecting the brain wave patterns associated to that assignment. In the case of applications for disabled people: hands free applications to control an electric wheelchair; Monitoring sleep disorders - currently people are required to spend entire nights at clinics in order to perform these tests; early detection of epileptic seizures; Games: controlling virtual environments only with the mind; Neuromarketing.



### Design patterns library for smartphone applications targeted at older adults 13

This project aims at creating a user interface design pattern library for senior adults under the umbrella of the S4S (Smartphones for Seniors) project. The input for the project will build upon the knowledge gathered with the Smart Companion, a project for which a vast number of usability tests have already been performed and documented. The main focus of research will be on user interface design patterns. These patterns should be structured, organized and developed in a way that allow for easy access through a simple Web application, which clients can access to guide their design and development processes. An interaction design pattern is defined as an effective solution to a recurring problem. The particular problem being addressed, in this work, has to do with issues related to touch-based interaction for senior adults. The literature review suggests that these might not be adequate for this particular audience, and therefore we propose creating a new user-defined approach to sets of gestures. This project intends to enable older adults to actively participate in the specification of the gestures they are expected to be able to use when interacting with touch-surfaces. The patterns will appear as a result of testing and analyzing these user-defined gestures against commercially available ones. We expect to uncover a more adequate set of gestures and document them in pattern form, in order to facilitate their adoption by interaction designers.

### Analysis and design of smartphone applications for older adults for Windows Phone 7

This project focuses on the analysis and design of smartphone applications for the S4S (Smartphones for Seniors) project. The work begins with a thorough user research (including literature review and possibly interviews with senior adults) to formalize the requirements of S4S. Afterwards, the gathered requirements in the form of people, scenarios, and case studies which will be used throughout the project will be formalized. Depending on the size of the user research phase, prototype solutions for the problems previously identified will be proposed. This project has a target group that is not the typical senior adult, but only those 55 years of age and above. So, it is necessary to carry out user research and gather the requirements for this age group, as well as to define their problems, an issue to be discussed further in the project.



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# SERVICE

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## LOCATION AND CONTACTS

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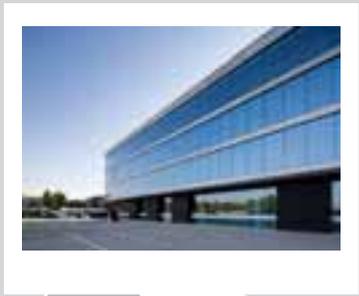
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