Fraunhofer

PORTUGAL

ASSOCIAÇÃO FRAUNHOFER PORTUGAL RESEARCH

ANNUAL REPORT 2013

Associação Fraunhofer Portugal Research

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 well-being by contributing to the population's quality of life.

Currently, the Associação Fraunhofer Portugal Research (Fraunhofer Portugal) owns and operates the Fraunhofer Portugal Research Center 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 atividades 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 Associação Fraunhofer Portugal Research 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 Center 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.

ANNUAL REPORT 2013

Fraunhofer Portugal: Results that matter!

Despite the ongoing crisis in Portugal the year 2013 has been the most successful year for Fraunhofer Portugal ever!

We were able to leverage strongly on the work we carried out in the years before and exceeded by far our already demanding plans for 2013. We achieved an outstanding result from our external research activities that is 36% above the planned volume, which budgeted for a growth of 26% compared to the year 2012, thus we finally reached an absolute growth of 72% in project revenues vs. 2012!

This number is even more impressive considering the fact that on the side of our operational expenses we just required 6% more than budgeted. In short, we were able to increase the efficiency of our activity by 15% and have achieved now a revenue over operating expenditures (OPEX) of 58%.

At the same time we have been able to prepare the year 2014 very well: More than 78% of the planned external revenues from research activities have already been contracted. Thus we are looking forward to exceed the expectations of our stakeholders once more.

In addition, and not yet part of our planned revenues, we are expecting the first income from the license contracts that have been signed related to our flagship development 'Smart Companion'. Among other opportunities our licensing partner was able to win internal support of a large European mobile network operator based on our smartphone solution for seniors and the market introduction by the operator is planned to happen in 2014.

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On top, and based on two filed patents from 2010 and 2013 in the area of indoor positioning, we were able to attract interest from a couple of companies, two of them belonging to the largest in their markets. We were able to achieve outstanding results with our PIL (Precision Indoor Location) technology: We are able to track bearers of smartphones with an accuracy of approximately 1m with little or, in the best case, no additional infrastructure requirements. The estimated market volume of solutions that would benefit from the knowledge of the location of a user is overwhelming as this information allows other technical systems to perform significantly better. It is maybe a good comparison to say, that this technology might have a similar importance of what the eyes do have for humans. While being already in the top league of the available technologies, our solution is very young and our team is constantly developing new ideas for additional improvements. At the time of writing this report we are about to file another patent to protect our Intellectual Property Rights in order to ensure our ability to participate in the success of future solutions.

It is important to mention that both examples above are part of the activities we are carrying out under the umbrella of the 'Fall Competence Center (FCC)', a large internal cluster of projects of Fraunhofer AICOS, which is partly financed by the FEDER funded Portuguese QREN/ON2 programme 'Projects for Scientific Research and Technological Development[4]'. This funding helps us strongly to demonstrate the innovation capability that our German-Portuguese joint venture was able to develop.

Under the same programme line Fraunhofer AICOS also was able to win a second project, the 'ICT4D Competence Center', which targets on the development of software for mobile solution in developing countries, specifically in the Sub-Saharan region of Africa. Even though we were facing some unexpected problems at the beginning, we are now working with our partners from Mozambique, South Africa, Germany and Portugal on very interesting projects that have been defined mainly by the interests of our African partners. We also expect in this project very valuable results that will be the basis for innovations and thus will lead to opportunities for commercial success.

Related to all activities has also been a growth of our human resources and our plan for 2014 leads us to a team of ap-proximately 100 employees. As this is exceeding the capacity of our current installation we have decided already in 2013 to expand by adding a branch office of Fraunhofer AICOS in the Lisbon region in 2014. A potential location for the branch has already been identified and at the time of writing we are about to start detailed negotiations to establish a team of ini-tially 10 people in a scientifically complementary environment. By creating the branch office in Lisbon we expect also to have increased opportunities to cooperate with all the universities of this region. We have already observed in our headquarter in Porto the potential of the 'complementary thinking' that results from teaming up with the Faculty of Medicine of the University of Porto, Portuguese Institute of Oncology, or National Health Institute Dr. Ricardo Jorge in different projects and therefore we are convinced that those intellectual 'joint-ventures' will stimulate new and exciting developments also for the next years.

Dirk Elias

Fraunhofer Portugal: Resultados que fazem a diferença!

Apesar da atual crise em Portugal, 2013 foi o ano mais bem-sucedido de sempre para a Fraunhofer Portugal!

Fomos capazes de alavancar fortemente o trabalho realizado nos anos anteriores e excedemos amplamente os nossos planos para 2013. Atingimos um resultado excecional com as nossas atividades de investigação externas, 36% acima do volume planeado, o qual previa um crescimento de 26% quando comparado com 2012, conseguindo-se assim um crescimento absoluto de 72% em receitas de projetos, por comparação com o ano 2012!

Este número é ainda mais impressionante quando consideramos que do lado da despesa operacional apenas necessitámos mais 6% do que o valor orçamentado. Em suma, fomos capazes de aumentar a eficiência da nossa atividade em 15%, atingindo agora um volume de receitas sobre despesas operacionais (OPEX) de 58%.

Em simultâneo, conseguimos preparar bastante bem o ano 2014: mais de 78% das receitas planeadas relacionadas com as atividades de investigação externas estão já contratadas. Como tal, esperamos mais uma vez ter a capacidade de superar as expectativas dos nossos "stakeholders".

Adicionalmente, e para além das receitas planeadas, estamos a aguardar as primeiras receitas provenientes dos contratos de licenciamento assinados ao abrigo do nosso projeto de referência Smart Companion. Entre outras oportunidades, o nosso parceiro de licenciamento conseguiu conquistar o apoio interno de um operador de telecomunicações europeu de grande dimensão, baseado na nossa solução de smartphone para seniores, e o lançamento no mercado está planeado para acontecer em 2014.

Adicionalmente, e com base em dois pedidos de patente na área de localização "indoor", submetidos entre 2010 e 2013, conseguimos despertar o interesse de algumas empresas, estando duas delas entre as de maior dimensão no mercado onde operam. Conquistamos também resultados excecionais com a nossa tecnologia PIL (Precision Indoor Location): conseguimos localizar utilizadores de smartphones, com uma precisão de aproximadamente 1m, praticamente sem recorrer a infraestruturas adicionais. O volume de mercado estimado para soluções que beneficiarão do conhecimento sobre a localização de um utilizador é avassalador, uma vez que esta solução permitirá que outros sistemas técnicos melhorem significativamente a sua performance. Possivelmente, podemos equiparar a importância desta tecnologia ao que os olhos representam para os humanos. Pese embora já se encontrar entre o topo da oferta disponível para este tipo de tecnologias, a nossa solução é ainda bastante prematura, pelo que a nossa equipa está permanentemente a desenvolver novas ideias para a melhorar. À data da redação deste relatório, estamos prestes a submeter um novo pedido de patente com o intuito de proteger os nossos direitos de propriedade intelectual e assegurar a possibilidade de contribuir para o êxito de soluções futuras.

É importante referir que ambos os exemplos mencionados acima fazem parte das atividades que temos vindo a desenvolver sob a alçada do "Fall Competence Center (FCC)", um grande "cluster" de projetos internos do Fraunhofer AICOS, financiado em parte pelo FEDER, programa português de financiamento QREN/ON2 "Projetos de Investigação Científica e Desenvolvimento Tecnológico". Este financiamento tem-nos ajudado a demonstrar a capacidade de inovação que a nossa aliança luso-alemã foi capaz de desenvolver.

Ainda sob o mesmo programa, o Fraunhofer AICOS conseguiu conquistar um segundo projeto, o ICT4D Competence Center, que se destina ao desenvolvimento de software para soluções móveis para países em desenvolvimento, em particular para a região da África subsaariana. Apesar de no início termos encontrado algumas dificuldades inesperadas, estamos agora a trabalhar com os nossos parceiros em Moçambique, África do Sul, Alemanha e Portugal, em projetos bastante interessantes que têm sido definidos essencialmente pelos interesses dos nossos parceiros africanos. Com este projeto esperamos também atingir resultados muito importantes que servirão como base para inovações que conduzam a oportunidades com sucesso comercial.

Relacionado com todas estas atividades está também o crescimento dos nossos recursos humanos, pelo que o nosso plano para 2014 prevê uma equipa de aproximadamente 100 funcionários. Visto que isto ultrapassa a capacidade das nossas instalações atuais, foi decidido em 2013 avançar com uma expansão, adicionando uma extensão do Fraunhofer AICOS na região de Lisboa em 2014. Uma localização potencial foi já identificada e à data da redação deste relatório estamos prestes a iniciar uma negociação detalhada com o intuito de estabelecer uma equipa de 10 colaboradores num ambiente complementar às nossas atividades. Com a criação desta extensão em Lisboa, esperamos também aumentar as oportunidades para cooperar com todas as universidades da região. Na nossa sede do Porto, já nos foi possível observar o potencial de um "pensamento complementar" que advém da cooperação com a Faculdade de Medicina da Universidade do Porto, o Instituto Português de Oncologia e o Instituto Nacional de Saúde Dr. Ricardo Jorge em diversos projetos. Como tal, estamos convictos que estas "alianças intelectuais" vão estimular novos e empolgantes desenvolvimentos para os próximos anos.
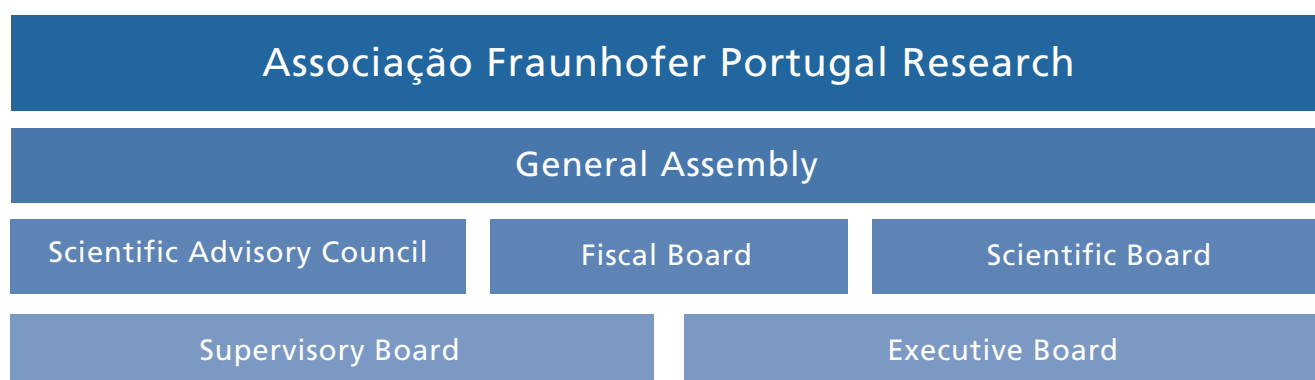
Dirk Elias
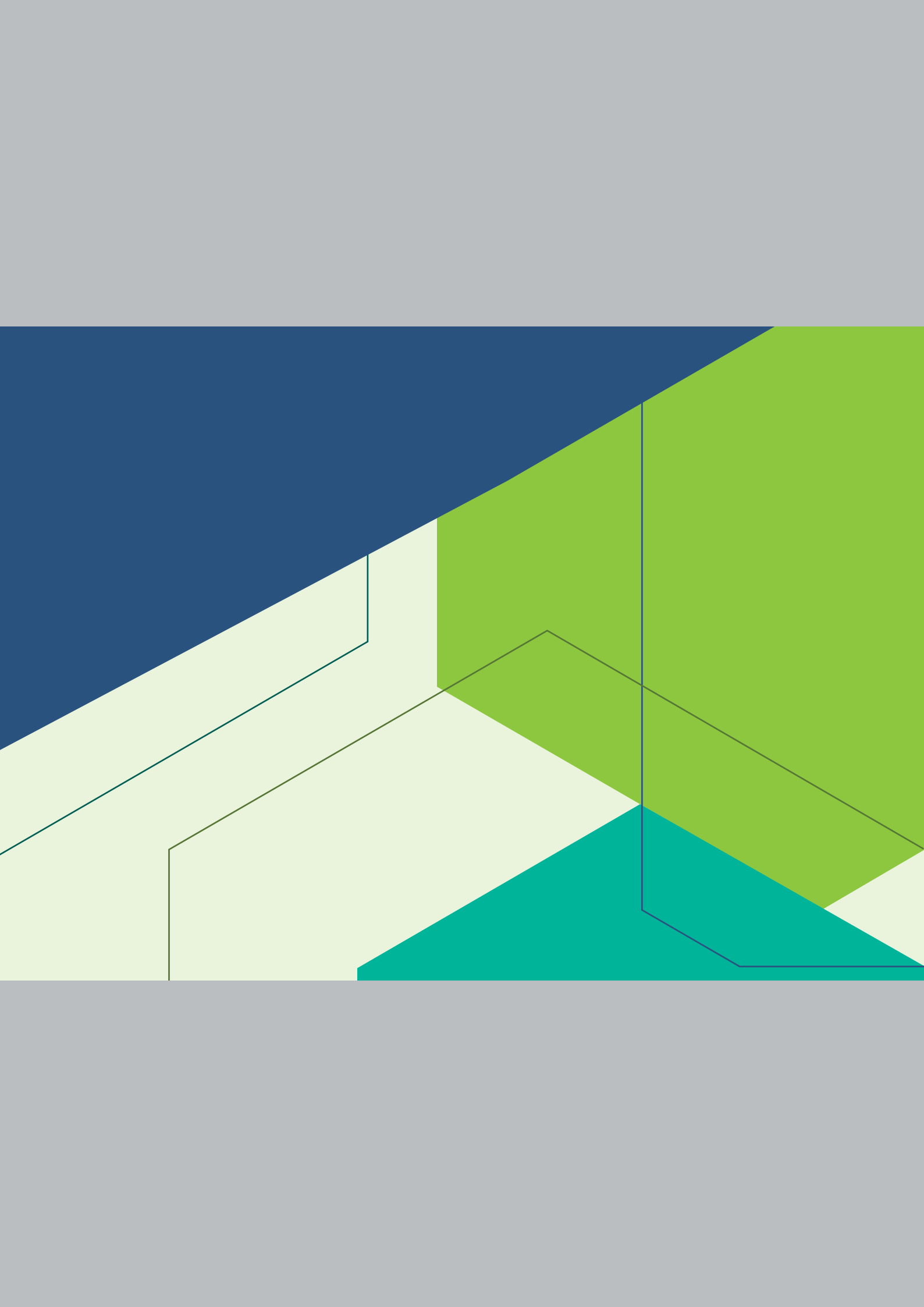
REPORT OF THE EXECUTIVE BOARD

GOVERNANCE & MANAGEMENT

OVERVIEW OF FRAUNHOFER PORTUGAL

MANAGEMENT REPORT 2013

THE EXECUTIVE BOARD

GOVERNANCE STRUCTURE

Associação Fraunhofer Portugal Research		
General Assembly		
Scientific Advisory Council	Fiscal Board	Scientific Board
Supervisory Board		Executive Board

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 manage-ment and current management actions).

SUPERVISORY BOARD

President
Georg Rosenfeld
Division Director Research
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.

Dirk Elias 2
President of the Executive Board

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.

Functional Assignments: General Administration, R&D Planning, Business Development, Facilities.

Pedro Almeida 1
Executive Board Member

With a professional career that started form R&D activities to the full innovation cycle with the creation of a spin-off of a prestigious University in Portugal, Pedro Almeida holds a MSc. in Electronics and Telecommunications Engineering by the University of Aveiro, and holds a post-graduation in Advances Management for Executives also from the same university.

Functional Assignments: Business Development, Planning & Control, Accountancy & Finances, Human Resources, Legal, Facilities.

Berthold Butscher 3
Executive Board Member

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.

Functional Assignments: R&D Planning Support.

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.
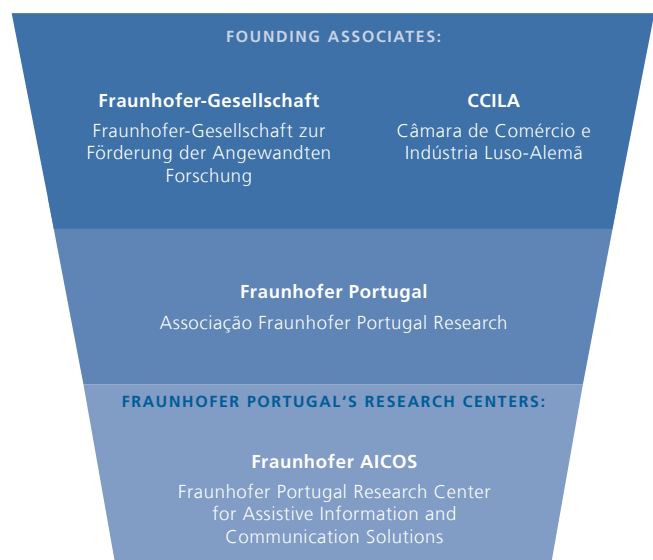
Funding Model

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.

FOUNDING ASSOCIATES:

Fraunhofer-Gesellschaft
Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung

CCILA
Câmara de Comércio e Indústria Luso-Alemã

Fraunhofer Portugal
Associação Fraunhofer Portugal Research

FRAUNHOFER PORTUGAL'S RESEARCH CENTERS:

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

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Fraunhofer-Gesellschaft

Research of practical utility lies at the heart of all activities pursued by the 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 solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains 67 institutes and research units. The majority of the more than 23,000 staff are qualified scientists and engineers, who work with an annual research budget of 2 billion euros. Of this sum, more than 1.7 billion euros is generated through contract research. More than 70 percent of the 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 until five or ten years from now.

International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to re-inforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up 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 by virtue of the practical training and experience they have acquired.

The Fraunhofer-Gesellschaft is a recognised non-profit organization that takes its name from 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.

Associação Fraunhofer Portugal Research

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 well-being 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 (AAL) and Information and Communication Technologies for Development (ICT4D).

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.

Fraunhofer AICOS

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 specialised 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 fulfil its mission. Therefore, Fraunhofer AICOS strongly promotes and consolidates partnerships and cooperation with key players and decision makers in its strategic research areas, namely:

– Center of Excellence for Dematerialization of Transactions: leading entity that coordinates a network of knowledge and competences in the dematerialization of transactions in Portugal;

– Eduardo Mondlane University (Mozambique): the oldest and largest university in Mozambique focused on producing and disseminating scientific knowledge, as well as promoting innovation through research, educating generations to face challenges to benefit society's development, namely in the scientific fields of Biology, Agronomy, Engineering, Human Sciences and Linguistics;

– Faculty of Economics of the University of Porto: with a long and prestigious history in the teaching of Economics and Management in Portugal, it is considered the best Portuguese University according to most international rankings;

– Faculty of Engineering of the University of Porto: a top-level faculty that awards degrees in several engineering fields, such as: mechanical engineering, computer engineering, chemical engineering, etc.;

– Faculty of Medicine of the University of Porto: well renowned faculty that promotes teaching, scientific research of excellency and medical support activities to the community;

– Fraunhofer FOKUS (Germany): 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;

– Fraunhofer IDMT (Germany): Fraunhofer Institute focused on developing cutting-edge solutions in the digital media domain, consistently designed to meet user requirements and expectations;

– 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;

– ISCTE - University Institute of Lisbon: a public university that pursues teaching, research and community service activities, in areas such as: business, sociology, public policy, social sciences, technology and architecture;

– National Health Institute Dr. Ricardo Jorge: public organization of the Ministry of Health, endowed with scientific, technical, administrative, financial and property of its own, that develops a triple role as State Laboratory in the Health Sector, National Reference Laboratory and National Health Observatory;

– Nelson Mandela Metropolitan University (South Africa): a dynamic African university offering professional and vocational training, for its leadership in generating cutting-edge knowledge for a sustainable future, specialised in the scientific fields of Health, Engineering, Business and Economics and Law;

– Polytechnic University of Catalonia (Spain): a public institution dedicated to higher education and research, specialised in the fields of engineering, architecture and science;

– Portuguese Institute of Oncology: the largest national institution dedicated to the research, diagnosis, treatment and studying, prevention and teaching within the domain of oncologic diseases;

– Professional Rehabilitation Center of Gaia: an association focused on the rehabilitation of people affected by accidents or diseases, which also assists young people with disabilities to transition from school into an active life;

– University of Limerick (Ireland): distinctive, pioneering and connected university that undertakes world-class research and delivers innovative teaching in the fields of Science and Engineering;

– University of Porto: our primary and distinguished university partner offering access to university know-how and infrastructures, as well as privileged contact with students interested in enrolling in advanced training at Fraunhofer AICOS labs. Naturally we have closer cooperation with some of its faculties, namely the ones described above;

– UPTEC: official Science and Technology Park of University of Porto that fosters the creation of technology-based companies and the establishment of national and international private R&D centers, supporting an effective knowledge and technology transfer between academia and the market.

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 and healthcare 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 their daily 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 and to reduce the digital divide.

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 are directly related with 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 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.

MANAGEMENT REPORT 2013

Summary of Key Figures

	2013	2014 (Plan)
Total Budget	2.386.466	3.234.394
Staff Costs	1.710.686	2.093.258
Non Personnel Costs	535.258	740.570
Industry Revenues	570.880	730.000
Public Revenues & Others	739.340	979.842
Base Funding	1.076.246	1.524.551
FTE (Full Time Equivalent)	42,3	53,3

Economic and Political Background

In 2013 the development of the Portuguese economy continued to be strongly influenced by the adjustment process of the macroeconomic imbalances. The necessary measures to correct the imbalance involved the adoption of a number of fiscal consolidation measures and a gradual deleveraging of the private sector, which resulted in a strong contraction in domestic demand and consequently a gradual adjustment of the size and investments of the private sector.

2013 was also marked by the continued application of the Economic and Financial Assistance Programme (EFAP) in a particularly unfavourable external economic environment, namely with the euro area facing a possible recession, that was only overcome in the last semester of 2013, and an external economic environment that was highly uncertain and with several threats to the consolidation of the Portuguese economy. Being the Portuguese economy highly dependable of the external market to overcome the economic crisis and to leverage the growth of Portuguese SMEs, this year was marked by a strong budget consolidation being applied in all companies of the private sector independently of their size, which originated significant cuts in the budgets available for R&D and Innovation in the national market.

Although the national and external economic environments were hostile, along the year the Portuguese economy evolved positively and evidenced a marked correction in its domestic and external imbalances, which resulted in an increase in the net financing capacity of the Portuguese economy and an allocation of resources to economic sectors that produce tradable goods and services. After a cumulative contraction in the last years (2011–2013) of 6% in the Portuguese economy, a moderate recovery of activity was achieved by the end of 2013, being the current estimates for 2014 and 2015 of a slight growth of the Portuguese economy and the end of the contraction cycle. Current projections of Banco de Portugal indicate that by the end of 2013 the change in Gross Domestic Product (GDP) will be -1,5%, and in 2014 and 2015 the change in GDP will be 0,8% and 1.3% respectively. Having in consideration that in the next years the Portuguese economy will be growing and improving its performance, it is expected that the SMEs that had to apply severe budget cuts in the R&D departments, due to the economic crisis, start to relieve the cuts and will be able to start investing again in innovation and R&D projects to maintain their competitiveness.

In terms of the political environment at national level, 2013 was also marked by some uncertainty that resulted in subsequent changes in the government along the year.

In the beginning of the year 2013 a first reorganization was implemented that lead to changes at the level of Secretary's of State, namely the Secretary of State for Entrepreneurship, Competitiveness and Innovation. During this adjustment, the previous Executive Director of Fraunhofer Portugal, Eng. Miguel Barbosa, was invited to join the Portuguese Government as an assistant of the new Secretary of State, Dr. Franquelim Alves, and he assumed the functions of Advisor to the Secretary of State for Entrepreneurship, Competitiveness and Innovation.

Later on, at the beginning of the second semester of 2013, another reorganization of the government lead once more to a change of the Secretary of State for Entrepreneurship Competitiveness and Innovation, but Eng. Miguel Barbosa became also part of the new team and thus did not reengage with Fraunhofer Portugal.

As the current funding programme, QREN, is coming to an end and the new funding program, Portugal 2020, is still being prepared and discussed, no significant measures or policies related to Innovation and R&D activities targeting at 2014 were presented in 2013. Actually the main focus of the activities promoted by central administration entities was related with the preparation of the next structural funds that will be made available by the European Union for the period 2014–2020. According to the information announced recently by the Government, the main priority will be to promote the competitiveness and internationalization of the Portuguese economy and more than 40% of the funds will go towards the objective of Competitiveness and Internationalization, most notably to help SMEs to grow in size and gain market share outside the national borders. The other priorities are the development of human capital, I&D, social inclusion, employment and an efficient and sustainable use of resources.

The new year seems more promising as the political environment seems to be more stable and the economic indicators are also positive and encouraging. Fraunhofer Portugal is once again engaged in continuing to contribute to the success of the Portuguese economy and therefore it will continue to provide its services with the dedication, professionalism and quality that is expected from a leader R&D institution.

Business Evolution

The business evolution in 2013 was extremely positive and the results achieved reveal that the organization was able to grow significantly despite the economic crisis that affects most of the organizations in Portugal. This growth was only possible due to the strong commitment from all the members of the organization and due to the continued effort to produce outstanding results in the scientific areas where Fraunhofer AICOS is and intends to be a global leader. At the end of 2013, we are extremely pleased to be able to announce that we have achieved 136% of the planned objectives for our revenues, mainly due to the success of the business development activities, the scientific achievements and the strategic initiatives.

Business Development

In terms of Business Development, in 2013 Fraunhofer AICOS was able to significantly increase its portfolio of projects and enlarge its customer base, which is reflected in the significant increase of the contracted volume of projects in the current backlog. At the end of 2013 the contracted backlog increased significantly, when compared with the end of the previous years, and accounts to a total volume of contracted projects in the period 2013–2016 of 3.4M€. Although there was an initial delay regarding the decision about the financing of two important and strategic projects for Fraunhofer Portugal: the Fall Competence Center (FCC) and the Information and Communication Technologies for Development Competence Center (ICT4D-CC), during the second quarter of 2013 the positive result of the re-evaluation of the projects was received and the contract was signed with the funding agency.

An important aspect is that due to the dimension of the financial operation of both Competence Centers, the revenues contracted for national projects in 2014 and 2015 also increased, which creates a unique opportunity to fund our internal activities and create added value for industry. These projects will have a significant impact on the development and growth of Fraunhofer Portugal at several levels, and it is expected that the results generated by both Competence Centers will allow Fraunhofer Portugal to consolidate its actual leadership position by providing the necessary resources to expand its competitive advantage in specific areas of Ambient Assisted Living and ICT4D.

The funding of these Competence Centers is considered as start-up financing for future solutions with significant relevance to industrial customers. A first and extremely exciting outcome is the merging of the indoor positioning technology ULF-MC with the knowledge coming from the movement-detection through sensor-fusion. Combining both resulted in the core technology for a precision indoor positioning system capable to provide an accuracy of less than a meter with very low cost infrastructure demands. This solution is highly relevant for different sectors but especially to the retail sector and therefore another patent application was filed and a discussion with two companies that supply technological solutions to the retail market was started in order to evaluate the feasibility of the implementation of tools for 'precision shopping'. At the same time, one of Fraunhofer German institutes (FhI-IAIS) expressed its interest to explore the potential of this technology. From the current discussions it is likely that a positive outcome will be achieved during 2014, which might lead to new and joint project opportunities especially with the German retail industry.

During 2013 we continued also to successfully implement ground-breaking projects with our industrial customers, and actually we were able to repeat contracts with the same clients, which shows that our clients are satisfied with the results of our work and that we are able to transform their satisfaction into follow-up projects.

Although we achieved a significant success in terms of direct contracts with industry, the problems associated with the QREN programme still persist and we, and especially our industry clients, frequently suffered from the impact of delayed calls and project evaluation procedures, sometimes elusive budget cuts and in some cases unfortunately necessary objections related to scientific but not market driven evaluations.

In terms of EU projects one new project was contracted in 2013: ACP Street Libraries, and another one received a positive evaluation and is in the process to sign the contract: Clockwork. Despite these new projects being contracted at the end of 2013, most of the revenue generated in 2013 came from existing projects, namely E-NoFalls, Rempark and ChefMyself, therefore the main contribution of these projects for the revenues of Fraunhofer Portugal will be in the period 2014–2016.

All combined, the success of the project acquisition in 2013 allows us to start 2014 in a very comfortable position as a significant percentage of the revenues planned for 2014 are already secured by R&D contracts. This positive indicator gives us the optimism and the motivation to maintain our dedication and hard work to make 2014 another year of success for Fraunhofer Portugal. Year over year we are writing the success story of Fraunhofer Portugal!

Another important KPI related with our activity concerns with the capacity to involve German and Portuguese partners, either as contractors or partners, in the projects that we develop at Fraunhofer AICOS. During the period 2009–2013 we were able to generate 2.6M€ of revenues in projects that involve German or Portuguese partners, which reveals that we have strong commitment to work together with German and Portuguese institutions and therefore we also contribute to the strengthening of economic relations between Portugal and Germany.

Regarding 2013, we generated revenues of 65T€ with German subsidiaries in industry projects, 170T€ with German institutions in EU projects and 350T€ in national projects that include the participation of two Fraunhofer Institutes: Fraunhofer FOKUS and Fraunhofer IMDT. In terms of revenues that involve Portuguese partners, in 2013 we generated 388T€ with Portuguese companies and 265T€ in national projects.

Revenues Involving German Partners 2013

K€

65

170

350

%

11

29

60

- German subsidiaries
- International projects
- National projects
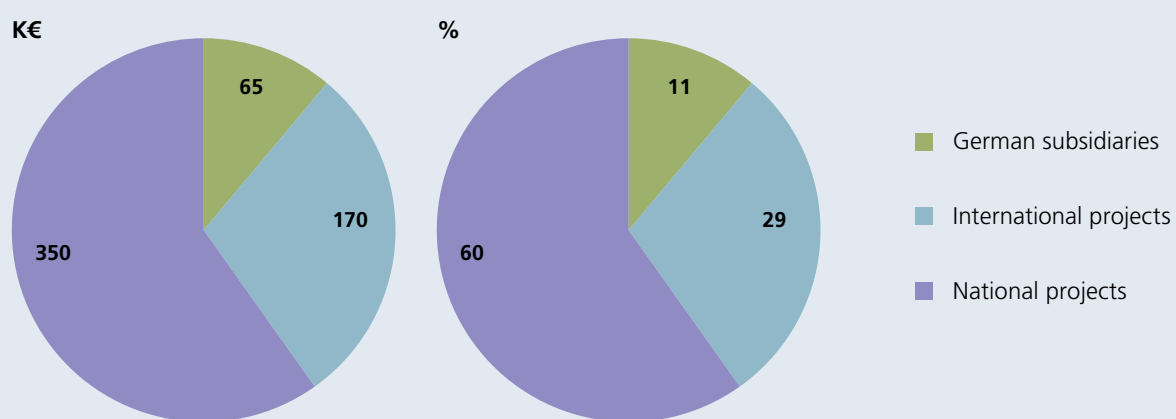
Revenues Involving Portuguese Partners 2013

K€

265

388

%

41

59

- Portuguese companies
- National projects
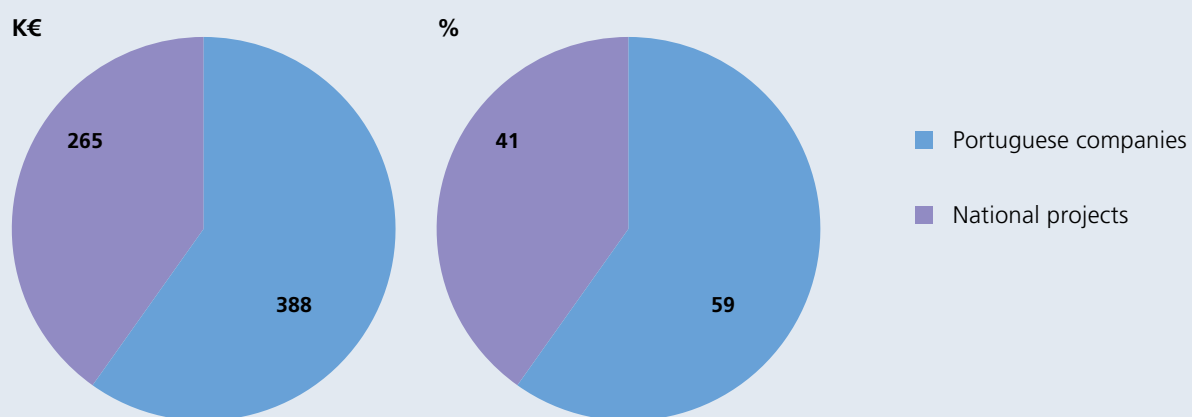
Scientific Results & Corporate Development

After a long period of waiting, approximately two years, in the second quarter of 2013 we were able to start two important and strategic projects for Fraunhofer AICOS: the 'Fall Competence Center (FCC)' and the 'Information and Communication Technologies for Development Competence Center (ICT4D-CC)'.

The FCC is partly financed by the FEDER funded Portuguese QREN/ON2 programme 'Projects for Scientific Research and Technological Development' and allowed us to create a large internal cluster of projects related with our scientific areas of Fall Detection and Activity Monitoring. The approval of the FCC allowed us to consolidate our positioning to be leaders, in terms of scientific results in these areas of knowledge, and the first results start to become visible. With the funding of the FCC we were able to achieve outstanding results with our PIL (Precision Indoor Location) technology. At the moment, this technology allows to track bearers of smartphones with an accuracy of approximately 1m with little or, in the best case, no additional infrastructure requirements. The information produced by PIL could then be used in several other solutions that could benefit from knowing the exact positioning of bearers of smartphones. Looking at potential external competitors that could provide similar technological solutions, our PIL solution has been recognised by industry as one of the best available technologies. As our solution is very young and our team is constantly developing new ideas for additional improvements we are confident that this technology has a strong potential to be licensed in a near future. During 2013 we filed one patent to protect our Intellectual Property Rights in order to ensure our ability to participate in the success of future solutions.

In addition, and not yet part of our planned revenues, we are expecting the first income from the license contracts that have been signed related to our flagship development 'Smart Companion'. Among other opportunities our licensing partner was able to win internal support of a large European mobile network operator and the market introduction by the operator is planned to happen in 2014.

In 2013 we were also able to start the activities of the ICT4D Competence Center (ICT4D-CC), which targets on the development of software for mobile solutions in developing countries, specifically in the Sub-Saharan region of Africa. At the beginning of the implementation of the ICT4D-CC we faced some unexpected difficulties that were promptly overcome and we are now working with our partners from Mozambique, South Africa, Germany and Portugal, namely Centro de Informática da Universidade Eduardo Mondlane, Nelson Mandela Metropolitan University, Fraunhofer FOKUS and the Faculty of Economics of the University of Porto, on very interesting projects that have been defined mainly by the interests of our African partners. Our expectation is that the ICT4D-CC will allow us to implement projects with very valuable results that later on will be the basis for innovations in Sub-Saharan countries and thus will lead to commercial opportunities in developing countries.

By the end of the year we also received positive news of our first EU funded project related with the ICT4D business field: ACP Street Libraries. This project aims to further develop a cultural activity already implemented in African countries, the Street Libraries, by reinforcing the existing actions and by creating the conditions to leverage and expand this concept to more African, Caribbean, Pacific (ACP) countries. The partners involved in the project - Microsoft MLDC, VPWA (NGO), ASRAD - Appui Solidaire Pour Le Renforcement De L'aide Au Developpement and YCWL - Youth Crime Watch of Liberia - plan to develop a set of activities related with the ACP Cultural sector promotion and consolidation, mainly by encouraging the preservation of local cultures that are currently only transmitted in oral format.

In terms of the results achieved in the scientific domain, the following table provides a summary of AICOS' activities with an important impact:

Scientific Activities	
Papers	19
Master's Theses	24
Patents (submitted)	1

In terms of Corporate Development, we are currently in the process to prepare an expansion of Fraunhofer AICOS by creating a branch research group in Lisbon. For this we have three main reasons:

- As we have industrial clients in Lisbon, a place to meet with them and to collaborate closely with other institutions in Lisbon would be of a great advantage;

- The second driver is related to a certain extent to the immobility of Portuguese researchers and we want to attract potential researchers from Lisbon;

- Last but not least, we are steadily growing and will reach the physical space limit of our installations in Porto by mid 2014.

Therefore we are currently in the process to identify potential co-location partners that are open for collaboration and are providing an added value to our research activities. Thus we are less concentrating on ICT-centric partners but more on groups that provide complementary knowledge.

2013 was also marked by the consolidation of our internal management tool, Project Control. Nowadays most of the project finance and progress execution is controlled by this internal tool and we are now able to access in real time deviations in our R&D projects. Project Control was also successfully used to calculate our Forecast 2013 and the Budget 2014 and allowed us to be more efficient, in terms of the time necessary to produce the final documentation related with both processes, and more accurate, as now we can drill down to individual values of CAPEX or OPEX expenses in any project and clearly identify every cost component that is contributing to the overall Budget.

Fraunhofer Portugal Challenge 2013 Winners

Fraunhofer Portugal in a partnership with ISCTE-IUL[1] organized the 1st International Workshop on Active and Healthy Ageing 2013, complementing the HealthCom' technological perspective with the Organizational and Human dimensions that are required for implementing an Ambient Assistive Living (AAL) environment. The topics covered were AAL architectures and business models, collaborative networks, ecosystems, organizational processes, care using ICT, effective working practices, cost-benefits analysis, acceptance studies, usability or change management. The multilateral benefits of the workshop on Active and Healthy Ageing' for the ALL stakeholders led to a win-win situation with enormous potential, not only for enhancing health quality and industrial competitiveness, but also for improving the use of financial and technological resources that are applied in healthcare and social care.

The 'Fraunhofer Portugal Challenge'[2] completed its fourth edition, reinforcing our high profile position within the Portuguese Academic Institutions. Once again, in this edition we were able to attract the interest of post graduate students who answered to our challenge with excellent scientific works. Evidencing this statement are the successful applications submitted from 8 universities country-wide, encompassing several heterogeneous courses, but in a certain sense, complementary to the scientific activities of Fraunhofer AICOS. As an example, the 6 finalists came from courses such as: Computer Science, Computer Engineering, Electrical and Computer Engineering, Informatics Engineering, Computational Biology and Biomedical Engineering.

Business Performance

– Business Volume over 2.3M€ and project revenues that surpassed 1.3M€.

– Revenues exceed by 36% the planned objectives for 2013.

In 2013 Fraunhofer AICOS maintained its growth trajectory and improved the performance of its activity.

For the first time our total Business Volume far surpassed the 2M€ threshold, representing an increase of 26% compared with last year. Although the increase of Business Volume was slightly above the initial plan for 2013, we were able to achieve a total value of revenues that surpassed 1.3M€, allowing us to break the 1M€ barrier of revenues for the first time.
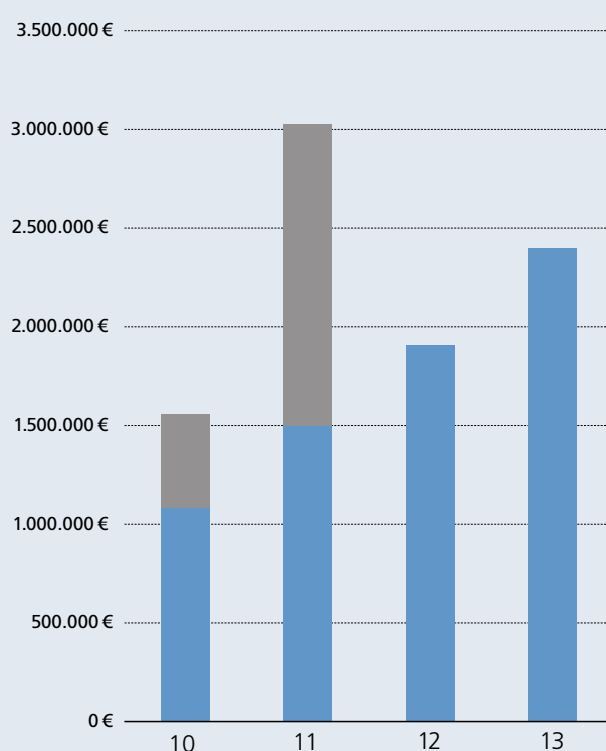
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1 *ISCTE-IUL – Instituto Universitário de Lisboa.*

2 *Scientific award rewarding MSc and PhD students from Portuguese Universities that developed 'Research of Practical Utility' in their thesis.*

As the internal projects start to achieve higher levels of maturity we are able to leverage results, i.e., external revenues, with the work that was carried before and we were able to exceed by far the goals of revenues defined for 2013. The total project revenues exceeded 1.3M€, 36% above the initial objective, and represents an increase of 72% when compared to the year of 2012. In terms of the performance improvement, to generate 36% of increase in revenues we only required 6% more of operational expenses than budgeted, which reveals our capacity to increase the efficiency of our activity.

Contrasting with the evolution of the Portuguese economy in 2013, our achievements allow us to consider this year as a significant success of our operation. This year we also increased the efficiency of our activity by 15% and we have achieved a revenue over operating expenditures (OPEX) of 58% vs 45% in 2012. In terms of the performance indicators related with the revenues over operating expenditures (OPEX) by type of projects, Industry revenues increased to 25% vs 21% in 2012, Public revenues increased to 22% vs 9% in 2012 and EU revenues decreased from 13% in 2012 to 11% in 2013 even though the absolute value increased.

Total Business Volume (cash basis) 2010–2013

	2010	2011	2012	2013
▉	555.556 €	1.522.082 €	-10.000 €	0.00 €
▉	1.056.560 €	1.504.012 €	1.903.541 €	2.386.466 €

▉ Major Infrastructure Capital Expenditure

▉ Contract Research
(Total Expenses and Research Capital Expenditure)

Contract Research

- 55% of Total Business Volume is financed by Project Revenue.

- Staff costs increased due to team growth and excellent performance.

- Non-Staff costs and CAPEX remain at steady level.

Personnel expenses for contract research increased 44%, and represented 76% of our total operational cost in the financial year of 2013, as a result of the project driven increase in staff.

Non-personnel costs grew only by 5%, as a result of an increasingly efficient cost structure. This increase can be explained by the increase in communication costs as in 2013, we were signing our own communication contracts, and by our estimate for services rendered by Fraunhofer Gesellschaft in 2013.

Capital expenditure with contract research decreased 27% when compared with 2012. This reduction of CAPEX expenditure is explained by the temporal and specific profile of the research projects being developed at Fraunhofer AICOS. Typically, the gross CAPEX expenditure is executed at the beginning of the research projects, and since we had several projects that started on the previous year the majority of the CAPEX needs was acquired at that stage.

Contract Research Revenue Evolution 2010–2013

	2010	2011	2012	2013
	251.070 €	516.141 €	761.998 €	1.310.220 €

Contract Research
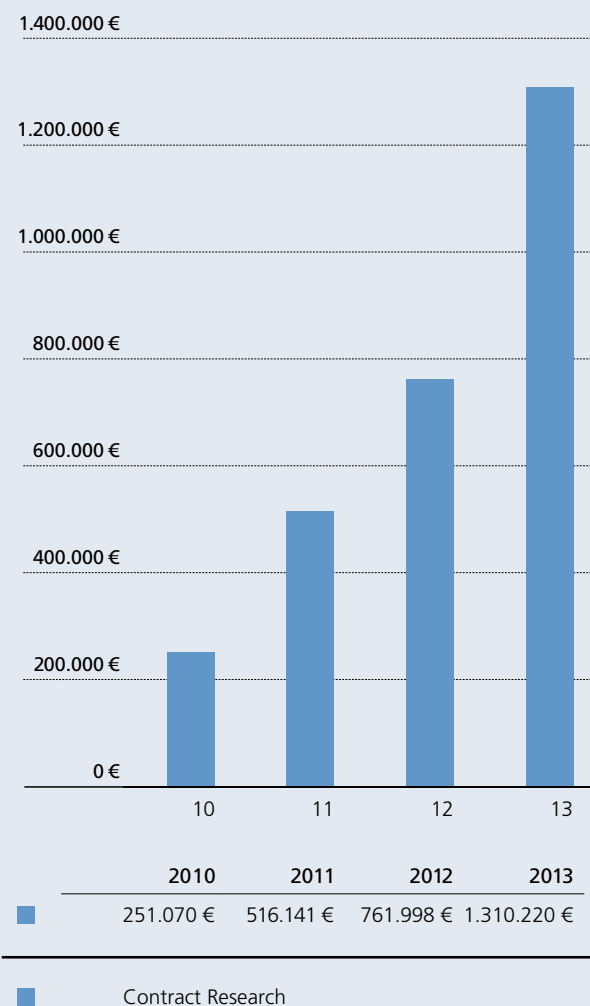
Fraunhofer AICOS significantly improved its revenues in 2013. Our revenues from projects evidence a steady and significant growth along the years 2010–2013, and an increase of 72% versus 2012.

The trend in industrial revenue was surprising when considering our mid-year expectations for 2013, increasing by the impressive magnitude of 161% versus 2012, which accounts for 43% of the total project revenue.

Revenue from public national projects ascended in 2013 to 37,3% of operating revenues, revealing a strong increase of 337% when compared to the last year. The increase is related to the approval of the Competence Center projects.

Revenue from EU-funded research projects also evidenced a considerable yoy increase, rising 9%. Since 2010, EU revenue has grown 78%.

Once again, in 2013 Fraunhofer Portugal was able to generate revenues by reusing results from existing internal projects and with the commitment and dedication of all employees we were able to exceed the planned R&D revenue results by 36% and achieve the most successful year in our history.

Employees

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

During 2013 we were able to increase our team by 23%, closing the year with a total headcount of 69 collaborators (regular staff, grant holders and external collaborators) corresponding to 42,3 FTE (Full-time equivalent). Also important to highlight, we have outnumbered our previous year's number of PhD with a total of 6 doctorates, being this the higher number since the beginning of our activity. Notwithstanding, this significant growth has been accomplished in a sustainable form, 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 managed to maintain a significant gender distribution as we achieved, by the end of the year, a ratio of 26% female collaborators. Also, we run a highly qualified team, as 91% of our staff members have a university degree, 66% are MSc and 9% have a PhD degree.

Naturally the headcount evolution changes during the year due to the profile of our activity and the collaboration with students. We have therefore registered a peak of 80 people during the 1st quarter of 2013, and the average amount of people throughout the year was 73 people.

The positive evolution of FhP headcount registered in 2013, is a direct consequence of the rising number of research projects and contracts, evidencing that the Center's reputation among its clients and partners is becoming more solid and indicating that year after year we are building an image of professionalism and quality as an R&D institution of excellence.

Also, during 2013, some collaborators left Fraunhofer Portugal, as they were offered working contracts in the industry sector. This is a result of the training and technical skills learned at the Center and once more it proves that we are accomplishing our mission to increase the innovation pace of the Portuguese Economy, and we are contributing to its overall international competitiveness.

Regarding the Human Resources activity, and following our vision to motivate the team and promote merit and pro-activity of all collaborators, in the second quarter of 2013 we have proudly announced three 'Entry Level Excellence Awards' dedicated to young researchers that achieved outstanding results: António Rodrigues, Luís Rosado and Ricardo Moutinho.

Headcount Evolution

Year	Scientific, technical and administrative personnel
2009	26
2010	34
2011	40
2012	63
2013	69
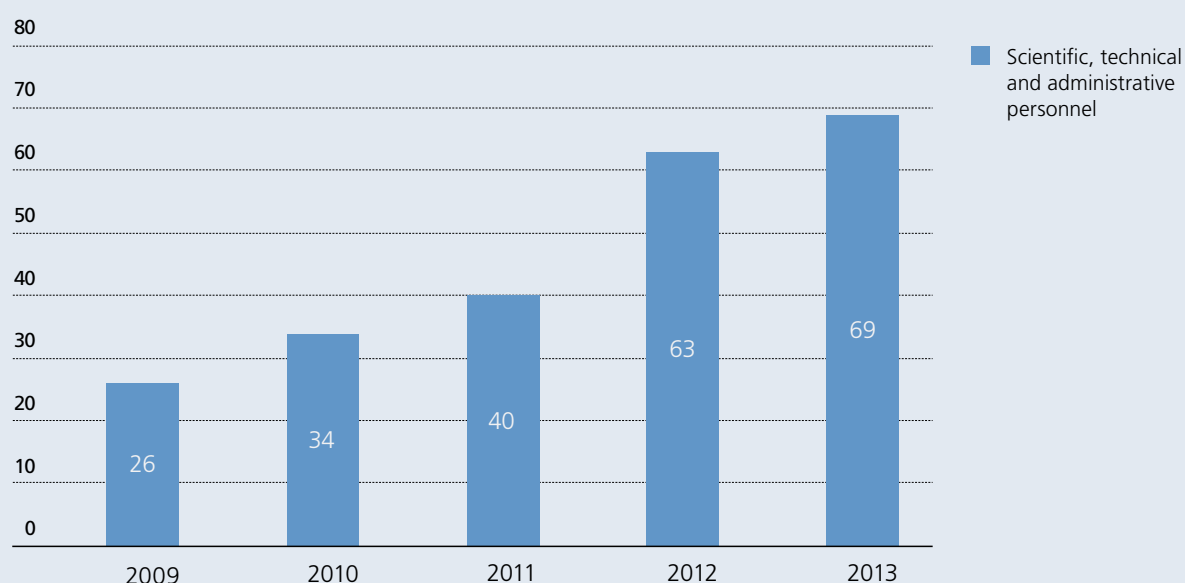
Outlook and Strategic Development

As already stated in the editorial part of this document at the beginning, results matter! This is true for our revenues, but even more for our scientific output. Due to our applied approach, both parameters are strongly interconnected, as our customers need to be able to achieve a return on the investment they are doing when contracting us to help them to innovate.

This is in particular important for our internal projects, as those have to be designed to meet the future demand of potential customers. In the past years we were able to demonstrate, that our decisions got confirmed by our clients to a large extend. The absolute majority of our projects that started as a simple thesis or as small internal R&D project today are contributing with the background knowledge and skills of the team to external projects.

With the increasing team size this need is growing stronger and it is getting more difficult to stay focused. Therefore we appreciate a lot the availability of the Portuguese funding authorities that granted the two competence center projects FCC and ICT4D-CC. They help us a lot to concentrate our activities in two very promising fields and at the same time to grow the related teams to a critical mass that allows us to develop with the speed that industry is expecting. Being a scientific institution that serves industrial clients demands requires our capability to invest and to make entrepreneurial decision similar to the ones made by our clients.

This is specifically true, when it comes to projects that involve SMEs as they often lack the ability to pre-finance the projects they require to carry out in a time frame that meets the window of opportunity their respective markets provide.

This said and in combination with the fact that the current funding programmes related to QREN are phasing out, we hope that the next generation of programmes will stronger take into account the time to market aspect, as the current programmes often were characterized by excessive delays in calls, decisions and administrative prerequisites, thus weakening the position of Portuguese companies in international dimensions.

In addition, often the proposals for the innovation programmes seem to be evaluated under aspects related to more basic scientific background. Even a personal scientific merit of the individual project participants is making a significant part of the decision.

All this leads to artificial changes and project designs that are sub-optimal for the potential success of the related outcome. It needs to be understood, that the power of innovation often lies in the heads of the younger team members. The older and more experienced are helpful when it comes to the management and channelling towards the right direction. This is true not only for the industry innovation projects, but also for applied scientific projects that aim to prepare innovations. What is the contribution of a 'primary investigator' that is interested to extend his curriculum by leveraging on the ideas that bright students have in a project environment that targets to provide technologies that matter to industry in order to innovate?

A radical change is needed and the start of the new programmes is a huge chance to break with traditions that proved in the past to fail too often.

The most negative effect of all of the above is the creation of an artificial environment when it comes to the criteria for investment decisions of companies related to innovations. The companies have to face reality as an opportunity and the related programmes need to support this.

Thus the programmes need to be created around valid investment decisions that companies have to make by their own, based on their own internal discussions. Helpful therefore are programmes that enable the implementation of innovation activities at the same pace as the markets develop. This requires rapid access to financing (!) and also involves the availability to carry a financial risk from the side of the company. In parallel companies should be able ask for funding that might be granted based on first milestone achievements and then supports the companies that are likely to meet their innovation plans e.g. by supplying additional money to increase the speed of implementation and thus turning the idea even faster into a product.

Fraunhofer Portugal would appreciate a lot changes into that direction as we are dedicated to support companies in their research and development process with on-time result deliveries that matter!

Therefore we concentrate our business development efforts this year to rapid movers that are interested to launch developments independent of time consuming programme applications. A special focus will be on the deployment of our internal projects and background knowledge.

Specifically we intend to address the opportunities that are related to the two most promising developments we follow at the moment:

–   Smart Companion
    We are awaiting our licensing client and develop-
    ment customer Gociety to be able to sign a license
    agreement with a large European mobile network
    operator soon in order to launch a product to the
    customers of the operator in 2014. This will require
    various customization activities, that to a certain
    extent are not in the main focus of our research
    activities, but are necessary for a successful product
    launch. It will also require our availability to provide
    maintenance and support for the solution during the
    initial phase, which again is out of the scope of our
    R&D activities. Therefore and given the market entry
    will become successful, we are planning to spin-off
    those activities into a dedicated start-up still in 2014.

– Precision Indoor Location (PIL)
Between 2010 and today, in a still ongoing internal activity, a team of AICOS researchers has been developing a highly accurate indoor positioning system, called PIL. Already two patents have been filed, a third is about to get filed and a fourth is in preparation. Currently there is a high interest in the topic from the side of different industries, among them large companies like Google or Apple. AICOS is currently in discussions with two highly interested companies that individually, or within a joint venture, are interested to license the technology. A priority market is the retail business, but the use case scenarios that have been identified contain already more than 40 identified market opportunities, that are within the business area of only one of the industrial partners. AICOS therefore will continue to invest in the solution, which is considered by us as the most precise available but at the same time being among the most economic (almost no infrastructure required) solutions.

In combination with the success in acquiring many new projects we were also growing our team and we predict for the year 2014 a team size of 90 people or more. Thus we reach the maximum occupancy of our current installations in Porto and therefore have decided to extend our presence by an office in Lisbon. This extension will take place in Lisbon, as already for many years we felt also the need to be able to receive local customers and to present our solutions, but refrained from setting up a pure 'show room' due to cost reasons. In addition we consider a second location as being helpful to attract skilled personnel and to cooperate more closely also with experts in the Portuguese capital.

Therefore we have been conducting an informal research to identify complementary scientific groups working in areas that are connected with our research focus, being AAL and ICT4D. As a result we are now in detailed discussions with potential co-location partners and we are expecting a confirmation to go ahead soon. We were also at the same time able to identify a candidate, a professor of a renowned university in Lisbon, that would be suitable to head the branch office.

In a nutshell, the year 2014 again will bring lots of exciting developments and changes. We consider us being prepared and thus we are looking forward to again achieve excellent results that matter!

Perspetivas e Desenvolvimento Estratégico

Tal como foi mencionado no Editorial deste relatório, os resultados fazem a diferença! Isto é verdade para as receitas que conseguimos, mas é ainda mais para os resultados científicos que alcançámos. Devido à nossa estratégia de investigação aplicada, ambos os parâmetros estão fortemente interligados, uma vez que os nossos clientes necessitam de assegurar um retorno do investimento que estão a fazer quando nos contratam para os ajudar a inovar.

Isto é particularmente importante para os nossos projetos internos, pois têm que ser planeados de forma a colmatar as futuras necessidades dos nossos potenciais clientes. Nos anos anteriores conseguimos demonstrar que as nossas decisões foram amplamente validadas pelos nossos clientes. A grande maioria dos nossos projetos que começaram como uma simples tese ou como pequenos projeto internos de I&D, contribuem hoje com o "background knowledge" e com as competências da nossa equipa na realização de projetos externos.

Com o crescimento da equipa esta necessidade está a acentuar-se e torna-se mais difícil manter o foco. Por conseguinte, estamos extremamente gratos pela disponibilidade demonstrada pelas entidades Portuguesas responsáveis pelos programas de financiamento que nos aprovaram os dois projetos para a criação dos centros de competências FCC e ICT4D-CC. Estes projetos ajudaram-nos a concentrar bastante as nossas atividades em dois campos de investigação promissores e ao mesmo tempo a aumentar as respetivas equipas de investigação, conseguindo-se assim obter uma massa crítica de recursos que nos permite desenvolver os projetos de investigação a uma velocidade compatível com as necessidades da indústria. Sendo nós uma instituição científica que responde às solicitações de clientes do sector industrial, temos que ter a capacidade de fazer investimentos e tomar decisões empresariais similares às dos nossos clientes.

Isto é especificamente verdade em projetos que envolvem PME, uma vez que geralmente não possuem a capacidade para pré-financiar os projetos que pretendem desenvolver dentro de uma janela de oportunidade que vá ao encontro das oportunidades oferecidas pelo mercado em que atuam.

Dito isto, e em conjugação com o facto de os atuais programas de financiamento QREN estarem em fase de encerramento, temos a esperança que a próxima geração de programas tenha em consideração a componente do tempo de mercado, uma vez que os programas atuais foram caracterizados por excessivos atrasos nos concursos, decisões e pré-requisitos administrativos, o que coloca as empresas portuguesas numa posição enfraquecida quando comparadas com o contexto internacional.

Para além disso, não raras vezes as propostas submetidas aos programas de apoio à inovação parecem ser avaliadas por aspetos mais relacionados com conhecimento científico base. Até mesmo o mérito científico individual de cada pessoa da equipa do projeto tem um peso significativo na decisão final.

Todos estes fatores levam a que sejam introduzidas modificações artificiais no desenho dos projetos, que estão longe do modelo ótimo para alcançar o sucesso e resultados esperados. É necessário perceber-se que o poder da inovação muitas vezes está nos cérebros dos membros mais jovens das equipas. Os mais seniores e mais experientes são uma ajuda preciosa no que diz respeito às tarefas de gestão ou a canalizar o esforço de trabalho na direção certa. Isto é verdade não apenas para projetos de inovação com a indústria mas também para projetos de investigação aplicada que procuram preparar o caminho para esta inovação. Qual é o contributo de um "investigador principal" que está interessado em fazer crescer o seu currículo, alavancando-o nas ideias que alunos brilhantes têm, num ambiente de projeto que tem como alvo fornecer tecnologias que sejam relevantes para a indústria, em detrimento de serem inovadoras?

É necessário uma mudança radical e o arranque dos novos programas é uma excelente oportunidade para romper com a tradição, que no passado e de forma comprovada, falhou diversas vezes.

O efeito mais negativo de tudo o que foi dito acima, é a criação de um ambiente artificial que condiciona as empresas no momento da tomada de decisões sobre investimento em inovação. As empresas têm que encarar a realidade como uma oportunidade e este tipo de programas deve suportar esta decisão.

Assim, os programas têm que ser criados para suportar decisões de investimento válidas que as empresas têm que tomar por si próprias, baseadas nas suas próprias discussões internas. Como tal, serão úteis os programas que propiciem a implementação de atividades inovadoras capazes de acompanhar o ritmo a que o mercado se desenvolve. Isto requer um rápido acesso ao financiamento (!) mas também envolve a capacidade da empresa para, do seu lado, suportar parte deste risco. Em paralelo, deve ser permitido às empresas solicitar financiamento em função do cumprimento das primeiras "milestones" e também deve dar suporte às empresas que previsivelmente irão cumprir com os seus planos de inovação, como por exemplo, atribuindo financiamento adicional que permita aumentar a velocidade de implementação, permitindo, de uma forma mais veloz, transformar a ideia num produto.

A Fraunhofer Portugal apreciaria que se verificassem múltiplas mudanças neste sentido, uma vez que nos dedicamos a apoiar as empresas nos seus processos de investigação e desenvolvimento com a entrega em tempo útil, de resultados que fazem a diferença.

Por conseguinte, este ano concentraremos o nosso esforço de desenvolvimento de negócio para os agentes de mudança rápidos, que estejam interessados em lançar investigação e desenvolvimento sem recorrer aos morosos processos de candidaturas a programas de financiamento. Em especial, iremos focar-nos no lançamento dos nossos projetos internos e na consequente aquisição de "background knowledge".

Mais especificamente, tencionamos abordar as oportunidades relacionadas com as duas linhas de investigação mais promissoras que seguimos atualmente:

– Smart Companion
Estamos a aguardar que o nosso cliente de licenciamento e desenvolvimento "Gociety" consiga, a breve prazo, firmar um acordo com um operador de telecomunicações europeu de grande dimensão, para o lançamento do produto junto dos clientes deste operador em 2014. Isto irá requerer várias atividades de customização, que de certa forma saem fora do âmbito das nossas atividades de investigação, mas são essenciais para o sucesso do lançamento do produto. Irá também ser necessário apelar à nossa capacidade para fornecer serviços de manutenção e suporte para a solução, durante a fase inicial, algo que sai também fora do âmbito das nossas atividades de I&D. Assim sendo, e acreditando que o lançamento no mercado seja um sucesso, estamos a planear transferir estas atividades para uma empresa "start-up"ainda durante 2014.

– Precision Indoor Location (PIL)
De 2010 até aos dias de hoje, numa atividade interna ainda a decorrer, uma equipa de investigadores do AICOS tem vindo a desenvolver um sistema preciso de localização "indoor" chamado PIL. Já submetemos dois pedidos de patente, um terceiro pedido está prestes a ser submetido e um quarto pedido está já em preparação. Verifica-se atualmente um elevado interesse neste tópico por parte de diferentes indústrias, de entre as quais se destacam algumas empresas de grande dimensão como a Google e a Apple. O AICOS está em negociações com duas empresas que estão bastante interessadas, quer de forma individual quer sob a forma de uma "joint venture", e que demonstraram interesse em licenciar esta tecnologia. Um mercado prioritário é o sector do retalho, mas os cenários de utilização que têm vindo a ser identificados, contêm já mais de 40 oportunidades de mercado assinaladas, e isto apenas para uma das áreas de um dos parceiros industriais. Como tal, o AICOS irá continuar a investir nesta solução, a qual consideramos ter o maior grau de precisão, ao mesmo tempo que se situa entre as mais económicas (quase não necessita de infraestrutura).

Em combinação com o sucesso da aquisição de diversos novos projetos, estamos também a aumentar a nossa equipa e prevemos chegar a 90 ou mais colaboradores em 2014. Uma vez que este número corresponde à ocupação máxima das nossas atuais instalações no Porto, tomamos a decisão de expandir a nossa presença, com uma nova extensão em Lisboa. Esta expansão irá realizar-se em Lisboa, uma vez que nos últimos anos temos sentido a necessidade de receber clientes desta região e apresentar as nossas soluções, mas abstivemo-nos de instalar um mero "show room", essencialmente por razões económicas. Para além disto, consideramos uma segunda localização como sendo uma mais-valia para atrair pessoas especializadas, bem como para colaborar de forma mais estreita com especialistas na capital Portuguesa.

Por conseguinte, temos vindo a realizar uma pesquisa informal para identificar grupos científicos complementares que trabalhem em áreas relacionadas com a nossa investigação principal, AAL e ICT4D. Como resultado, estamos agora em discussão detalhada com um potencial parceiro para a nova localização e aguardamos a confirmação que nos permitirá avançar com este processo. Conseguimos também, em simultâneo, identificar um candidato para o lugar de diretor da extensão, que é também professor numa universidade de renome.

Em suma, 2014 irá proporcionar uma vez mais inúmeros e excitantes desenvolvimentos e mudanças. Nós consideramo-nos preparados e, como tal, esperamos novamente alcançar resultados excelentes, que fazem a diferença.

MARKET OUTLOOK

AMBIENT ASSISTED LIVING TECHNOLOGIES

ICT4D: REVOLUTION ACROSS SUB-SAHARAN AFRICA

AMBIENT ASSISTED LIVING TECHNOLOGIES

Assisted living technologies help aged people to live independent lives and provide affordable assistance and care through the usage of information and communication technology. This provides enhanced safety and assistance for daily activities of the aged, and it can be provided at home or even at institutions that offer specialised services and continuous care to the aged people.

The market for Ambient Assisted Living (AAL) related products is underlined by a strong regional diversity in healthcare and social security systems. In some countries, solutions for the private sector are a priority, while in others the same solutions will become part of the public welfare, but will face a set of constraints that might be irrelevant for the private sector. Also, the different societal set-up in different countries determines different levels of involvement by informal caregivers, which needs to be considered in designing AAL solutions and business models. In addition AAL is focusing more on prevention aspects while most healthcare systems still focus on treatment.

The business environment to address this huge market is influenced by those differences. The absence of a standard and easily replicable business models lead to a limited investment activity from the side of the industry. As a consequence, existing solutions tend more to originate from the electronic or mobile health (mHealth) environment. Nevertheless, the AAL services' market provides opportunities and, due to current low adoption rates, there is an abundance of scope left untapped.

Market Overview: Economics and Healthcare Expenditure

According to the World Health Organization (WHO), Non-Communicable Diseases (NCD), such as cardiovascular diseases, cancer, chronic respiratory diseases and diabetes, are the leading cause of mortality in the world, representing 63% of all deaths. Of the 36 million people who died from NCDs in 2008, 27 million were over 60. The largest burden – 80% or 28 million – occurs in low and middle income countries, making NCDs a major cause of poverty and an urgent development issue. NCDs will be the leading global cause of disability by 2030. The World Economic Forum and the Harvard School of Public Health estimated a cumulative output loss due to NCDs together with mental disorders to be US$ 47 trillion by 2030. This loss represents 75% of worldwide GDP in 2010, amounting to US$ 63 trillion.

In most of the European countries, healthcare expenditure represents more than 7% of GDP and share a similar context of growing. Labour markets, pension systems and social care systems in general are being heavily affected by the rapid ageing of the inhabitants of the industrialized world, accompanied by a diminishing number of 'economically active' people. Consequently, social care costs will rise with this demographic shift because it will lead to a higher ratio of people with disabilities or chronic illnesses. In the case of elderly people, in particular, the increase in multi-morbid disease patterns is already well-known.

Economies of Europe are struggling to match the increasing demand for well-being and social care from the populations with the supply of funds. Most of the economies are emerging from the impact of the recessionary phase and are looking for affordable alternatives technologies that allow optimum usage of limited resources.

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The AAL services market is driven by the increasing need for technological support in providing social care for the ageing population. As the spending on healthcare systems is mostly determined by the costs of the medical services and the costs of the over-utilization of these medical services, assisted living technologies will help in bringing down the healthcare spending by solving problems in care coordination and enhancing the well-being and the way chronic diseases are monitored and controlled.

Assisted living technologies focus on primary care, making it more intensive and using it also to drive down the use of hospitals, expensive treatments and diagnostic tools. By providing people an assistive environment – a 'care-at-home' type of solution that focus on wellness, monitoring and early intervention – it is possible to react faster and solve less complex health problems and yet to allow the access to specialists and to medicines. The technology enabled support is much sought after due to its efficient and effective solutions. In this respect, ICT – namely mobile technology – plays a key role as an enabler of efficiencies in the healthcare delivery value chain.

It is estimated that assistive environments oriented for primary care and ambulatory shift (care at residence or institution) can reduce the cost of healthcare and treatments between 30% and 50%, and release capacity of 'advanced care' (specialists, hospitals, etc.) for surgery, transplant, obstetric and paediatric care, acute care, long-term care, mental health treatment, trauma, cancer and end-of-life treatments.

Market Overview: Technology and Care Coordination

Half of deaths caused by NCDs are preventable. Prevention can be achieved through increased health literacy, awareness and behavioural changes aimed at reducing common risk factors. Prevention represents a cost-effective solution for alleviating the economic burden of NCDs, for reducing mortality and morbidity and for contributing to higher economic growth. Prevention allows limited resources to be focused efficiently on patients most in need.

Strengthening healthcare systems to combat NCDs requires effective, multi-sectorial and inter-sectorial strategies at the global, regional and national levels that are fully integrated into healthcare systems and extend beyond the traditional health sector. Governments are willing to help to prevent and manage these diseases effectively[1]. Other private and public stakeholders also play a major role in increasing awareness and education, improving early detection and disease surveillance and management.

Poor care coordination is a major cause of over-utilization of the medical services. Poor care coordination is mainly determined by a number of non-interconnected tools used in the care systems, the absence of healthcare standard systems and a non-holistic view of the information systems – e.g. one electronic health record that aggregates all the patient information and makes it available digital and structured, connecting the isolated healthcare information systems and allowing the use of big data technics to enable sustained and quality decisions as well as a deeper insight into causes and effects.

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1 *'Health 2020: A European policy framework and strategy for the 21st century', World Health Organization, 2013.*
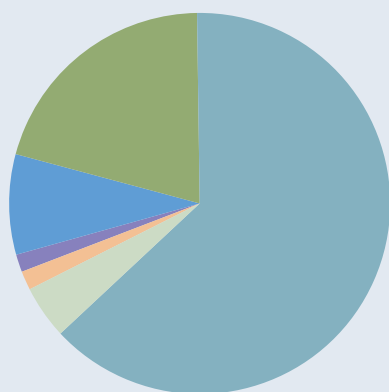
The move to Electronic Medical Records is obviously on the way, however not all the systems are compatible or interconnected and, of course, it will take time because of its complexity and privacy issues. A number of companies acting on the digital health business field are aiming to link these systems providing a web or cloud based solution. Others are addressing the problem of producing big data insights from human health care data (which is very tricky).

Broadband communication, Wi-Fi and networking capacity is widely available. The assistive environments can integrate sets of sensors, monitoring and care devices with virtually any Electronic Medical Record system. Efficient integration of devices allows communication between homes and community centers, as such it provides relevant data in time, in a regular way, facilitating the healthcare services.

Mobile is also poised to play a significant role in healthcare. In contrast to healthcare access, mobile access is becoming almost ubiquitous worldwide, with almost all developed markets already having mobile penetration greater than 100%. The worldwide mobile health revenue is expected to reach about US$ 23 billion across all stakeholders – mobile operators, device vendors, healthcare providers and content/application players - by 2017[2].

The European mobile health opportunity will be led by the Monitoring (65% - US$4.5 billion) and Treatment (16%) service categories. Healthcare Practitioner Support (5.5%) is also expected to find significant adoption, as can be seen bellow:

Mobile Health Market Opportunity by Services Categories in Europe, US$ billion and %, 2017

Monitoring	4.5	65%
Health Practitioner Support	0.4	6%
Wellness	0.2	3%
Prevention	0.1	2%
Diagnosis	0.6	8%
Treatment	1.1	16%

Source: PwC analysis

Market Overview: Demographics and Chronic Diseases

According to the European Commission report assessing the impact of ageing population on public spending (March 2006), from 2010 to 2050, in EU the active population will decrease by 16% (that is, 48 million people) while the over-65 population will go up by 77% (that is, 58 million). The ratio between the elderly and the 'economically active' is rapidly changing and threatens the viability of healthcare and pension systems that are founded on solidarity between the generations.

Countries are already facing similar health challenges today, particularly the development of chronic diseases by the ageing population. Chronic diseases represent a major risk today because they have surpassed communicable diseases as causes of mortality. They are often linked to individual lifestyles and are fostered by poorly balanced diets, lack of physical activity and tobacco or alcohol abuse. Today, cardiovascular disease, cancer, diabetes and chronic pulmonary diseases constitute a major problem and demand consuming and lifestyles behaviours to change.

In this respect, mobile health solutions also help in making in-depth information ready available and reducing the risk for major diseases and injuries by tackling health determinants. For example, the combination of wearable sensors, smartphones and web services creates personalized feedback on health parameters that is surprisingly effective in changing behaviour. As well as the use of home ecosystems and mobile media to foster healthier ways of life, for the generation and dissemination of health information and knowledge, and to promote healthier ways of

life (e.g. healthy food, physical exercise, smoking dangers, alcohol effects, etc.) aiming to stimulate healthier living, reduce addiction and, consequently, a cut back in health care expenses and funds needed for the care of these 'lifestyle diseases'.

The combination of very high mobile penetration worldwide, new consumer behaviours and technological innovations are changing the landscape of disease prevention and control. The widespread availability of mobile technology, including in many of the least developed countries, is an exceptional opportunity to expand the use of Mobile Health. mHealth interventions are already being successfully used to help people quit smoking, to better support diabetic patients through their treatment, to help health workers conduct household surveys to measure NCD prevention levels, to inform people about sporting and fitness opportunities and to help people maintain healthy food diaries.

Market Dynamics: drivers and restraints

With the emergence of chronic and degenerative diseases in the last years of life, the challenge lies not only in prolonging life but also in reducing age-related disability. The evolution of the number of years in poor health, as well as ageing, will determine medical needs and long-term healthcare in the coming years.

The key needs of older people include being autonomous, having a voice and belonging to the community. One of the most powerful strategies for promoting health and well-being in old age is preventing loneliness and isolation, in which support from families and peers plays a key role.

2 *'Touching lives through mobile health: assessment of the global market opportunity', PWC, February 2012.*

Initiatives for active and healthy ageing can benefit health and the quality of life. As such, ambient assisted living systems are the right answer for the growing elderly population in Europe. Putting an appropriate mix of services in place (such as health and social services, technical aids and support for informal care) is key to making health and long-term care systems sustainable in the future.

Another example is the integration of supportive technologies to monitor and improve the physical environment where elderly people stay longer. In Europe the environment-associated diseases cause one in five deaths[3]. Some examples include the following:

  – Exposure to particulate matter reduces the life expectancy of every person by an average of almost 1 year, mostly because of an increased risk of cardio-vascular and respiratory diseases and lung cancer;

  – Indoor air pollution from biological agents in indoor air related to damp and mold increases the risk of respiratory disease by 50%;

  – Environmental noise causes the loss of 2 million to 3 million DALYs (Disability-Adjusted Life Year) through increases in ischemic heart diseases, cognitive impairment of children, sleep disturbance, tinnitus and annoyance.

There are also major concerns with the promotion of heart health and the early detection of potential risks for heart failures. Cardiovascular diseases are a major health problem and the leading cause of death. In Europe, for example, every year nearly 2 million people die because of coronary heart disease, stroke and peripheral vascular disease. The heart failure risk is mostly explained by the High Cholesterol (46%), the sedentary lifestyle (37%), smoking (19%), high blood pressure (13%) and obesity (6%)[4]. These figures stress the importance of developing holistic solutions that help to keep a tracking record on weight and blood pressure, as well as to motivate for all types of leisure-time physical activities and to advice on the best dietary practices.

Final Considerations

Sensors and wearable medical equipment allows us to monitor human physical and health indexes at any given time, it can even examine the minutest change in human blood. All this information can be sent to the doctors in real time via wireless network. That allows doctors to make diagnosis and give treatment advice.

Assistive environments will assist even more the medical response in the future. We are beginning to see the proliferation of technologies in senior's residences and homes. This allows doctors to monitor many patients from the comfort of their own home or medical office.

The application of large databases - big data - is another important aspect of the healthcare field. A large medical database will be at the heart of the future healthcare industry as it can allow to determine the effectiveness and side effects of medicine in a more timely and accurate manner or it may even help to predict whether there will be flu or other diseases outbreak in the population within some time in advance. Large databases are therefore another important advancement in the healthcare field.

Currently CT[5], MRI[6] and other test methods still require diagnosis from doctors. In the future these sophisticated equipment can integrate all the images of medical records and can give its own diagnosis of the disease without doctor's participation. For this to happen, Cloud Computing has to be in place across healthcare field as it will enable to simultaneously transfer biometric information to the doctors for diagnosis and to simultaneously control the patients in their community and homes.

In the future people will be able to carry a mobile device, e.g., a smartphone that can monitor its health at any given time. In the case of an emergency incident, patients can be transferred to the hospital and diagnosed through an intelligent treatment system.

Digital and mobile healthcare services are bringing many changes in the healthcare sector. They are a huge opportunity now and they will be even more challenging in the future. Patients in general, and seniors in particular, will no longer have the need to go so often to the hospital in order to get treated. As such, the relationship between them and healthcare providers will become more flattened.

3   'Health 2020: A European policy framework and strategy for the 21st century', World Health Organization, 2013.
4   'Health in All Policies – Prospects and potentials', Finish Ministry of Social Affairs and Health, 2006.
5   CT - Computed Tomography.
6   MRI - Magnetic Resonance Imaging.

ICT4D: REVOLUTION ACROSS SUB-SAHARAN AFRICA

During the last decade, developing countries are experiencing an unprecedented increase in the number of users of cell phones and internet technologies, in association with the decline in the price of these devices and services (Lambert & Littlefield, 2009). In the universe of low and middle income regions, Sub-Saharan Africa (SSA) is experiencing an astonishing technological evolution, especially related to the booming of the mobile industry. Even so, it is anticipated (GSM Association, 2013) that the biggest impact of mobile in Africa is yet to come. There are still many challenges to be overcome and areas of opportunity waiting to be explored. The mobile revolution in SSA may be the key to reduce the global socio-economic and digital divide.

ICT4D in Africa

The concept of ICT4D denotes the study of information and communication technologies (ICTs) for socio-economic development. ICTs have long fostered community development, encompassing radio, television, telephone mainlines, computers and telecenters. These traditional ICTs have made little gains in SSA: usage has grown around 3-5% per year, compared to the 60-80% for internet and mobile phone usage (Sangonet, 2011).

Technology can have a role in different areas of socio-economic development for SSA. It has also been working as a tool to leverage the Millennium Development Goals established by the United Nations in 2000 (United Nations General Assembly, 2000). Furthermore, there has been strong involvement of international donors and service providers in creating ICT solutions for SSA. Herewith, two decades after ICTs began blazing trails across SSA, it is important to take time to analyse what challenges ICTs have met, what is their impact, what are the current barriers and how the enormous potential of ICTs can be realized, namely taking the form of a mobile revolution.

The Numbers of the Mobile Revolution

Sub-Saharan Africa has been revealing an extremely high growing rate in the mobile market. Mobile penetration rate has increased from 1% in 2000 to 54% in 2010. In 2013, the number of unique mobile subscribers in SSA reached 253 million with 502 million mobile connections established. Even so, SSA has only 8% of worldwide mobile connections, and mobile penetration is still lower than any other region. On the other hand, this can present an opportunity for investment and development. Alongside income growth, it is expected that SIM[7] cards penetration will continue to grow steadily over the next years, reaching over 75% in 2016 (Deloitte, 2012).

By far, the biggest consumers of mobile services in SSA are Gabon, Botswana, South Africa, Namibia and Mauritania with a penetration rate greater than 100% (Deloitte, 2012). On the other hand, the lowest rates are present in poorer countries like Eritrea, Somalia, Ethiopia, the Central African Republic or Malawi, under 30% of penetration. There are also some markets, like Nigeria, that even with low penetrations rates, present one of the greatest growth potentials for the next years. The rates presented are for SIM cards penetration, higher than unique subscriber penetration rates, as most phone users have multiple SIMs. Income levels are a key driver of differing penetration rates, though other factors including market structure, geography and regulatory environments also play their role.

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[7] *SIM - Subscriber Identity Module (a smart card inside a mobile phone, carrying an identification number unique to the owner, able to store personal data).*

The major mobile operators in SSA are MTN, Airtel, Orange, Vodafone (or Vodacom) and Millicom (Rao, 2011). As fixed line penetration is limited, mobile services can be delivered through basic phones, feature phones and smartphones. Basic phones are low-cost handsets essentially for calls and short message services (SMSs), being the most used in developing countries. Feature phones are between basic and smartphones, having one or more stand-out features such as music or camera capability. Smartphones allow access to internet and data rich services. At the end of 2012, smartphone penetration in SSA stood at 4%, below the global average of 17% (GSM Association, 2013). Smartphones are still not very used in Africa mainly because they are more expensive. Smartphone usage in SSA is primarily driven by young consumers under 30 years old. They usually own low range smartphones, typically costing less than US$ 150. South Africa, Nigeria and Kenya are leading markets in the region with regards to smartphone ownership (Ericsson Consumer-Lab, 2013).

Mobile apps are quickly incorporating more utility and productivity features. App culture in this region is also led by younger consumers. The usage of apps is fuelled by word-of-mouth and by the fact that they don't come with a price tag (Ericsson ConsumerLab, 2013).

Mobile connections, population and penetration in SSA since 2000; and map of mobile penetration, 2012
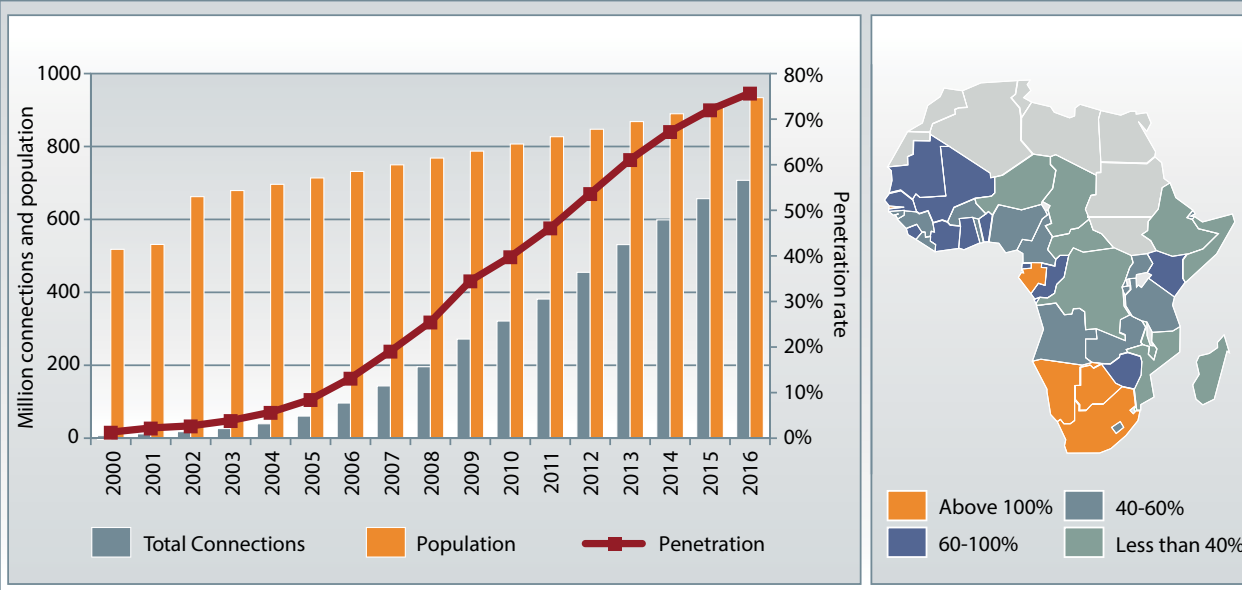
Source: Wireless Intelligence

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Sub-Saharan Africa vs Developed Countries

Over the last five years, the unique mobile subscriber base has grown by 18% per annum (GSM Association, 2013). With this, SSA is undoubtedly the fastest growing region in the world and it is expected to remain this way for the next decades. Average subscribers have close to two SIM cards each, more than in developed markets.

Compared to other basic amenities like sanitation and electricity, levels of adherence to mobile services are very high. But to reach the level of developed countries, SSA has still a lot of space for expansion. Less than one in three people in SSA have subscribed to mobile services, compared to more developed regions, such as the European Union, where the figure is currently four out of five people. This indicates that significant growth is still possible, per opposition with the mobile market stagnation that has been starting to take effect in the majority of developed countries.

On the other hand, efforts are being made since SSA countries spend, on average, a larger proportion of their income on mobile services than in other regions. An average of 15% of their income, compared to the 3-5% observed in other developing markets and less than 1% in US and Europe.

Technologies designed for developed countries are often incompatible with the ones that already exist in developing countries, especially due to the different infrastructures, habits and culture. The tailored incorporation of ICTs is then necessary and it is already showing promising results in some application areas, namely mGov, mHealth and mCommerce.

The Impact of Connecting the Unconnected

The growth of mobile industry in SSA is having a transformative effect on social and economic development. The mobile ecosystem has been helping the increase in SSA's GDP and job availability. As mobile contributes over 6% to GDP in SSA, direct employment caused by mobile growth rose to 3.3 million, a number that is expected to change to 6.6 million until 2020 (GSM Association, 2013).

Mobile technologies have also brought change to social issues. Connecting people through mobile transformed the way in which African communities lived: from the promotion of social cohesion to active citizenship, sharing of different experiences or stimulation of local contents. They can bring different communities together regardless of income, literacy or language. Mobile-based services can have further impact in healthcare, education, banking and local innovation in SSA.

As well as the enormous social and economic benefits, mobile ICTs have the potential to change fundamental business models in key sectors like banking, production or agriculture. Mobile technologies can leverage other services, as it is shown by the steady increase of launched mobile-enabled services over recent years. Particularly, mobile money services are very popular among SSA communities.

Mobile Trends

The cellular annual growing rate (unique subscriber growth) is expected to rise from 18% to 43% by 2017. By analysing current data on mobile distribution, it is expected (GSM Association, 2013) that subscriber growth will come predominantly from rural and lower income populations. Herewith comes the need for increased network coverage and affordability of mobile solutions.

Following the current trends, increasingly affordable handsets will dominate the market. Customized low-cost smartphones for Africa have already started to appear (Fripp, 2014; Hung, Erensen, & Sheng, 2012; Kagwe, 2013), bridging new possibilities for mobile deployments for this region. A key contributing factor to the extension of mobile services in SSA

will definitely depend on the availability of inexpensive and simplified handsets. Furthermore, mobile internet access and the appearance of innovative features will be facilitated by the increasing uptake of more advanced devices, including smartphones.

In the last two years, more than 50 mobile tech hubs have emerged in African capitals (Rao, 2011), including tech incubators and co-working spaces like the Hive Colab in Uganda, the iHub in Kenya, or Limbe Labs in Cameroon. A lot of mobile solutions for SSA are thus being locally deployed. Mobile Monday (Rao, 2012) identifies Angola and Ethiopia as key mobile market opportunities, namely in what relates to banking and social services.

Recently, there has been an increase on the usage of mobile solutions to address challenges in education, health, agriculture and governance. Particularly, mHealth has registered 250 active solutions across the region (GSM Association, 2013). Numerous deployments are projected for mAgriculture and mGoverment for the next years. GSMA also foresees a potential growth in basic voice services trying to surpass the challenge of local languages and illiteracy.

Barriers to be broken

Economic inequalities of the different consumer segments and disproportionate rates and taxes applied on the use of mobile phones are influencing the access to mobile services. Some local governments are not yet enthusiastic or have no money to invest in ICT infrastructures and services. In fact, major investments in the ICT ecosystem are highly dependent on NGOs[8] and other international institutions that try to replicate successful business models of other regions.

Additionally, the gender division is still a source of inequalities. For example, women in Africa are 43% less likely to have access to the internet than men. In several dimensions, it is necessary to redirect the mobile revolution to the discriminated sectors of SSA society.

Mobile market is also very dependent on the local operator's capacity to invest. Local markets are lacking pragmatic regulators and competition authorities to assure their long-term sustainability. Not to forget the challenge of improving network coverage, for now still very dependent on the limited grid-based electricity, support infrastructures and the high costs of extending coverage to low density populated areas. New proposed approaches for network expansion seem to encompass green technologies (solar, water, biomass…), network sharing and 3G or 4G deployments (GSM Association, 2013).

Yet, the full potential of mobile market can be leveraged with a more supportive regulatory and policy environment.

Final Considerations

Rising mobile penetration rates and improving network coverage will continue to be positive contributions to socio-economic growth in the region. The mobile revolution will continue, breaking barriers and resurfacing with new challenges. With this, Sub-Saharan Africa presents good prospects for mobile developments. It is the right time to take the gap on untapped potentials given by mobile growth in SSA. There are huge opportunities in locally relevant mobile content and services which open the door for international collaborations as well as for African innovators and developers.

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8 *NGO – Non-Governmental Organizations.*

REVIEW OF FRAUNHOFER PORTUGAL RESEARCH

STRATEGIC RESEARCH AGENDA

PROJECTS AND RESULTS 2013

STRATEGIC RESEARCH AGENDA

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

Business Fields

Fraunhofer AICOS addresses two main business fields: Ambient Assisted Living (AAL) and the emerging field Information and Communication Technologies for Development (ICT4D).

Ambient Assisted Living

Ambient Assisted Living (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 the increasing number of ageing population and the inversion of the demographic pyramid that is occurring in the developed countries. AAL technologies can be instrumental in tackling the massively increasing cost of healthcare and social security. 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 allow to extend the time senior citizens can live in their home environment with the proper comfort, safety and quality of life. These services will increase their autonomy and assist them in carrying out their 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 and safety, 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 reduce the digital divide and therefore contribute to poverty reduction in developing countries.

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.

Business Sub-Fields

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 conse-
quences 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 mon-
itoring of senior adult activity. Despite the market potential,
current technological solutions are cumbersome and are not
inclusive focusing on formal caregivers while at the same
time presenting cost obstacles and being, in general, hard to
handle and maintain. The Fraunhofer 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, chron-
ic 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 solutions. 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 as they can simplify their daily lives and
reduce their dependency on other people by taking advan-
tage 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
time. 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.

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).
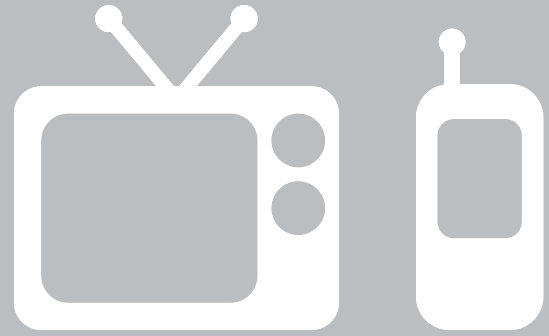
Core Competences

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 based on the demand of a specific customer, but the vast majority is related to our prediction of a future demand from the side of our customers. In order to gain competences, we are using internal projects that will ideally lead 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 only 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 communi-cation 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 compe-tence 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 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 at Fraunhofer AICOS to cope with the lack of interop-erability between devices and applications and the reduced remote management capabilities in AAL and ICT4D.
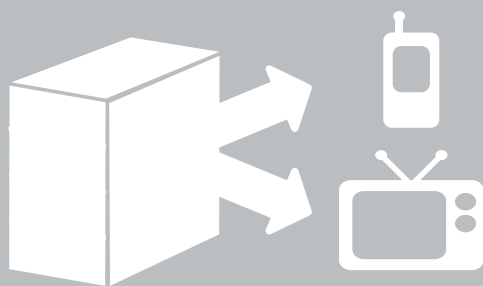
SMARTER MACHINES: LESS CONFIGURATION & MAINTENANCE

As a consequence of the work 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 Center (FCC). The FCC concentrates our efforts and extends 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 extended our activities in the emerging business field ICT4D through the creation of the ICT4D Competence Center, which concentrates all the competences needed to develop and assess solutions for mobile devices in the application fields of mAgriculture, mHealth, mGovernment and business solutions for the growing micro-enterprises in developing countries. It allows us also to form an international team with guests from Africa and Europe that have the potential to create a joint melting pot for the related activities of Fraunhofer in Germany.

EXTERNAL PROJECTS

In accordance with the Fraunhofer Business Model, two thirds of Fraunhofer Portugal's income should be generated by external projects which can have one of two formats: Industry Contract Research, i.e. projects having industry partners as clients, or Government Contract Research, i.e. projects resulting from the participation in national and EU publicly funded programmes. This section describes the current external projects that are being developed at Fraunhofer AICOS.

AAL4ALL – Primary care standard for AAL services

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 - Health Cluster Portugal - Polo de Competitividade da Saúde; Alcatel – Lucent; Critical Health; Associação CCG/ZGDV - Centro de Computação Gráfica; Be Artis - Concepção, Construção e Gestão de Redes de Comunicações; Casa de Saúde de Guimarães; CASO - Consultores Associados de Organizações e Informática; CeNTITVC - Centro de Nanotecnologia e Materiais Técnicos, Funcionais e Inteligentes; CITEVE - Centro Tecnológico das Indústrias Têxteis e do Vestuário de Portugal; Conforto em Casa; Criavision; Critical Health; Escola Superior de Educação de Paula Frassinetti; Exatronic - Engenharia e Electrónica; FCTUNL - Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa; FEUP - Faculdade de Engenharia da Universidade do Porto;

Glintt - Healthcare Solutions; INOV - Inesc Inovação - Instituto de Novas Tecnologias; Inovamais - Serviços de Consultadoria em Inovação Tecnológica; IPN - Instituto Pedro Nunes - Associação Para a Inovação e Desenvolvimento em Ciência e Tecnologia; ISCTE - Instituto Superior de Ciências do Trabalho e da Empresa; ISEP - Instituto Superior de Engenharia do Porto; I-Zone, Knowledge Systems; Meticube - Sistemas de Informação, Comunicação e Multimédia; Microsoft Portugal (MLDC); Optimus Comunicações; Plux- Engenharia de Biosensores; ProcessNet - Sistemas de Informação; PT Inovação; PT Prime - Soluções Empresariais de Telecomunicações e Sistemas; UBI - Universidade da Beira Interior; Universidade de Aveiro; Universidade do Minho.

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.

ACP Street Libraries – Culture for all [1]

Description: The main objective of the ACP Street Library project is to contribute to the development of culture in ACP countries mainly by promoting the creation of new Street Libraries and the modernization of existing ones. The partners involved in the project also plan to develop a set of activities related with the ACP Cultural sector promotion and consolidation mainly by encouraging the preservation of local cultures that are currently only transmitted in oral format.

Partners: Microsoft Portugal; VPWA - Volunteer Partnerships for West Africa; ASRAD - Appui Solidaire Pour Le Renforcement De L'aide Au Developpement; YCWL - Youth Crime Watch of Liberia.

Outcome: There are four specific objectives associated to the project implementation, namely:

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1. Increase the number of ACP Street Libraries;

2. Increase the number of books available for oral reading in ACP Street Libraries;

3. Improve existing databases of ACP countries local culture;

4. Improve ACP countries discussion and cooperation platforms.

The key stakeholders of the project will be actual and future cultural entrepreneurs, who will benefit from the project to promote and disseminate their artistic work; NGOs and private and public institutions, who will benefit from the project by building the necessary capacity to create new Street Libraries and cultural projects; universities and research centers, who will benefit from the new project results by promoting technology transfer to the local students, local partners and international ACP members; and finally, the local population, children and young people of ACP countries, who will have access to more cultural resources and who will be able to preserve their local legends and histories for the future generations. All the actions developed in the project will comply with user centered design methodologies, being the end-users always directly involved in all the project activities.

ChefMyself – Assistance solution for improving cooking skills and nutritional knowledge for independent elderly people 2

Description: The main goal of the ChefMyself project is to develop a customizable, open and extensible ICT service eco-system 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 re-quirements. 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 rela-tionships and the creation 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; Me.Te.Da; Polne SL (Taurus Group); Unie KBO; ASM Market Research and Analysis Center.

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.

EnAware – Domestic Energy Awareness 3

Description: The rising 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 can be seamlessly integrated 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 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 analysed in order to improve user comfort and, at the same time, motivate sustainable changes of behaviour.

Partners: Bosch Termotecnologia; EFACEC - Engenharia e Sistemas; EFAPEL - Empresa Fabril de Produtos Eléctricos.

Outcome: The EnAware system is composed of four main components: A household smartmeter provided by EFACEC, Zigbee-enabled smart-plugs and panels provided by EFAPEL, a Zigbee-enabled heatpump provided by Bosch, and the HomeServer developed and provided by Fraunhofer. The HomeServer is fully modular, being the main service developed using the OSGi specification, and is able to interact with all the equipment, collect and report consumptions, define and execute schedules, create and execute scenes, define goals, etc. The HomeServer is also able to run pluggable data analysis engines that provide data aggregation for faster query response times, consumer behaviour analysis, energy efficiency rating, etc., and provides a comprehensive and intuitive web portal that raises energy consumption awareness.

E-NO FALLS – European Network for Fall Prevention, Intervention and Security

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: Universitat Politècnica de Catalunya; Ana Aslan International Foundation; Charite - Universitaetsmedizin Berlin; Cooperativa Sociale Coss Marche Onlus Societa Cooperativa Per Azioni; Emergency Response; Fondazione Santa Lucia; Foundation for Research and Technology Hellas; Fundació Privada Cetemmsa; Fundació TicSalut; MCRoberts; National University Ireland Galway; Nordforce Technology; SeniorNett Norge; Siveco; Stichting Nederlands Normalisatie Instituut; Stichting Smart Homes, Nationaal Kenniscentrum voor Domotica & Slim Wonen; University of Limerick.

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.

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Family Live App

Description: The project aims to enhance people's living standards, specially focused on 'Ageing and Elderly', by offering them intuitive and useful technology solutions, capable of lowering technical and financial barriers that usually hamper them from using ICT and effectively participate in the Information Society. Among the different scientific activities at Fraunhofer Portugal, three projects are of particular relevance to this purpose: Smart Companion, a set of applications (Main screen App, Contacts App, Calls App, Messages App) for the Android smartphone that were specially designed to meet older adults' needs; Mover, an Activity Monitor and Fall Detector mobile application; and AlzNav, a monitoring and navigational application designed for older adults and people with dementia. Based on our current developments and on the client requirements, the project proposes the development plan for a single application denominated 'Family live app' with a unique look and feel, settings and generic environment.

Partner: Gociety.

Outcome: This project aims at delivering to FAMILY LIVE APP B.V. 3 apps developed in the context of 3 internal projects: Smart Companion, Mover and AlzNav. The initial phase will consist on delivering the current applications as they are, fully tested and documented with user guides and release notes. The final phase will provide all the apps in a single bundle and the homogenization of the User Interface of the different applications (it includes also a study of the best backend solution for the service to be provided).

FCC – Fall Competence Center 4

Description: The Fall Competence Center (FCC) aims to investigate in-depth all fall-related aspects, including activity monitoring and human motion analysis. The knowledge gathered in the FCC will be applied to viable solutions not only for fall detection, but also fall risk prediction and fall prevention. These technological developments are based on smartphones, since these devices are of easy access and continuously used in daily life. The new solutions have a great potential of being transferred to industry and converted into valuable products.

There are some specific groups presenting higher risks of fall and damage, the FCC target groups are:

– Elderly people;

– Patients with specific illnesses;

– Extreme sports athletes;

– Security field operatives.

Frequently these high risk individuals act/live alone and, after a fall, they are not able to ask for help and receive fast and efficient assistance, increasing the risk of serious injury after a fall. These groups clearly benefit from strategies to automatically send an alert and call for help when a fall occurs. Additionally to these reactive strategies, falls can be prevented by modifying some specific risk factors.

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Preliminary research results suggest that wearable inertial sensors can be a major strategy both to predict and detect falls and these topics are gaining attention from the research community. However, these strategies are not yet widely implemented, which makes falls an under-addressed health issue.

The new fall management solutions resulting from the FCC will allow to improve the efficiency of the assistance provided upon a fall and consequently minimise injuries, psychological damage, limitations on mobility and reduced quality of life. Therefore, these solutions are expected to have an important impact not only for individuals at higher risk of falling, but also in terms of improving the sustainability of health care systems.

Partners: Fraunhofer IDMT; Universitat Politècnica de Catalunya.

Outcome: Within the duration of 30 months three key results are targeted:

1. Development of four advanced prototypes dedicated to three different target groups (elderly people & patients with specific illnesses, extreme sports athletes and security guards) based on mobile devices;

2. Application for at least two patents to secure the Intellectual Property Rights outcome and to support the commercialization efforts;

3. Sustainable operation of the FCC after the funding period according to the Fraunhofer Model and collaboration with other international partners besides Fraunhofer IDMT.

The FCC will help to create 15 new research positions for students and researchers at Fraunhofer AICOS and, due to its international background, will also attract experts from outside of Portugal. The goals of the FCC have been endorsed by a number of leading international research institutions in the field, such as Fraunhofer IDMT, University of Limerick and Universitat Politècnica de Catalunya and are also in line with the strategy defined by the Health Cluster Portugal (HCP). Fraunhofer Portugal will make all the efforts to ensure that knowledge and results obtained will be disseminated into the related industry, reinforcing one of the main cluster objectives.

FLAvTwo – Family Live App Follow Up 5

Description: Based on the Smart Companion, a set of applications for the Android smartphone that were specially designed to meet older adults' needs; Mover, an Activity Monitor and Fall Detector mobile application; AlzNav, a monitoring and navigational application designed for older adults and people with dementia a first project was jointly developed by Fraunhofer AICOS and Gociety targeting an initial deployment and field testing in The Netherlands. This project is the follow up and starts from the point where the first project ended and intends to cover new requests that came up during the first project. FlavTwo project proposes the development of a set of new functionalities to be integrated in the Family Live Phone solution and, also, a new set of applications that meet the demands of the Dutch market.

Partner: Gociety.

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Outcome: This software release will include functionalities and new applications, namely a global Agenda app, a new advanced and more 'modern-looking' daily activity monitoring app and an emergency button app. In parallel a set of standard apps for sharing photos, videos, for Internet Messaging, browsing and e-mail will also be integrated. Moreover, Fraunhofer AICOS will also improve User Interface. The backend server will be updated to enable remote personalization of the phone with user preferences and a statistics module for battery life and others.

GameFoundry 6

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.
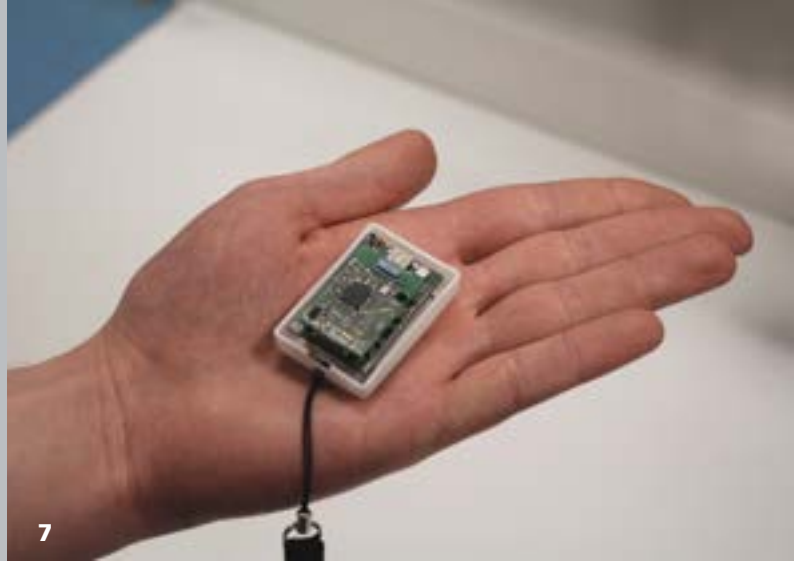
GocietySafetySensor 7

Description: This project arises as a complement to the Family Live App to address the following target users, detected during the Family Live App test phase:

– Women do not like to wear the smartphone around their waist or in their pocket. At home they tend to put the smartphone somewhere in the house on a table or cupboard, and when going out they prefer to wear the smartphone in their handbag;

– Men do not always wear the smartphone at home.

This means that the Family Live App is not running its activity monitoring and fall detection features on these users all the time, therefore an external sensor would be the perfect solution for them. This project aims for the development of such a solution, based on an external device that will be used as a pendant in the chest, and will connect to a smartphone through a low power wireless connection – Bluetooth Low Energy (BLE).

Partner: Gociety.

Outcome: The first release includes the development of the basic Safety Sensor device hardware and firmware that includes an 'alarm button' to enable the call for help or an assistance request. This version will also be capable of generating an alert when one of both devices is going out range of each other. The integration of these features with the smartphone will be done with a standalone Android application. The second release, in addition to all the functionalities

included in the former one, integrates the Safety Sensor with the Family Live Phone application, comprises the installation of a USB rechargeable battery and the embedding of motion sensors. This also includes the development of Distributed Fall Detection and Activity Monitoring algorithms to complement and cooperate with the existing algorithms in the Family Live Phone application.

ICT4DCC – ICT4D Competence Center

Description: The ICT for Development Competence Center (ICT4DCC) is an evolution of the highly successful 'Android for Developing' (A4D) project that Fraunhofer AICOS carried out in 2009/2010 with partners from industry (SAP Research, South Africa; PT Inovação, Portugal) and science (Centro de Informática da Universidade Eduardo Mondlane, Mozambique).

The goal of the ICT4DCC is to set up a team of international experts at Fraunhofer AICOS that are dedicated to the field and that will, within the related project, work with international partners from Mozambique (Centro de Informática da Universidade Eduardo Mondlane), South Africa (Nelson Mandela Metropolitan University), Germany (Fraunhofer FOKUS) and Portugal (Center for Economics and Finance of the Faculty of Economy of the University of Porto) to develop dedicated pre-commercial ICT solutions for:

1. Production in Agriculture;

2. Very Small Enterprises (VSE);

3. mHealth;

4. eGovernment – light Solutions for Citizens.

These activities will be accompanied and the solutions will be based on a set of transversal activities related to:

1. Socio-Economic Impact of ICT4D;

2. Local Requirements and KPI assessment;

3. Human Computer Interaction (HCI) and User Experience (UX);

4. Low Cost Networks;

5. Knowledge Transfer.

The main objective of the ICT4DCC is the investigation of all aspects and challenges of the application of state of the art of ICT in developing countries, with an initial focus on the African Sub-Sahara region namely Mozambique and South Africa. In addition, the Competence Center will focus on the development of several activities that will bring a sustainable benefit to the developing countries and the European partners.

Partners: CIUEM - Centro de Informática da Universidade Eduardo Mondlane; FEP - CEFUP - Center for Economics and Finance of the Faculty of Economy of the University of Porto; FEUP - Faculdade de Engenharia da Universidade do Porto; Fraunhofer FOKUS; NMMU - Nelson Mandela Metropolitan University.

Outcome: The key objective of the project is to supply pre-commercial ICT solutions for the populations of developing countries in the fields mAgriculture, VSE, mHealth, eGovernment.

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The results of the dedicated activities will be pre commercial SW solutions that fit the demands of the different fields, are iteratively tested and trialed and will be ready for deployment by enterprises that will need to customize, operate and maintain them. Depending on the solution, the enterprise will also need to provide specific content (e.g. expert know-how on crops, illnesses, etc.).

All in all the outcome of the project will be dedicated tool-boxes in order to start a rapid commercial deployment. Thus the result of the project will help to increase the growth of the ICT sector in Mozambique and Sub-Saharan African countries and will provide additional opportunities to Portuguese enterprises to participate, either as business partners of the ICT companies, or as indirect beneficiaries from the business sectors that profit from the ICT solutions.

REMPARK – Personal Health Device for the Remote and Autonomous Management of Parkinson's Disease 8

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: Association européenne pour la maladie de Parkinson; Centro Médico Teknon; Fondazione Santa Lucia; M&M Qualtech; Maccabi Healthcare Services; Mobile Solution Group; National University Ireland Galway; Nordforce Technology; Telefonica Investigacion y Desarrollo; Universitat Politècnica de Catalunya.

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 9

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 Portugal (MLDC); Universidade de Aveiro; FCUL - Faculdade de Ciências da Universidade de Lisboa; WIT Software; OPTIMUS – Comunicações; DevScope - Soluções de Sistemas e Tecnologias de Informação.

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

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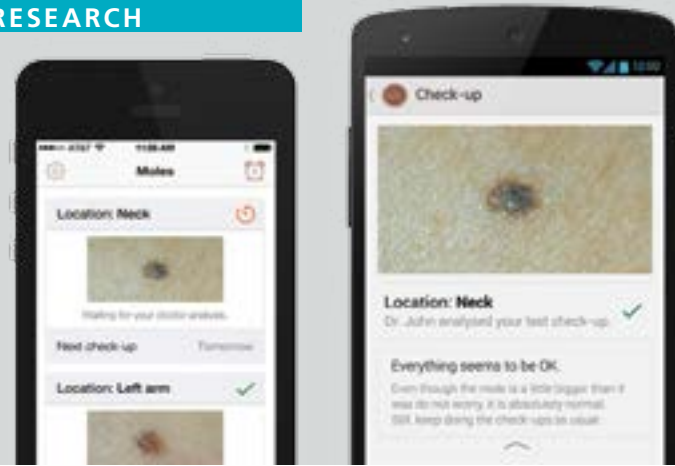
SAL – Service Assisted Living 10

Description: The Service Assisted Living project (SAL) is an Applied Engineering project that will study the application of Service Engineering and the adoption of Ambient Assisted Living technologies in the construction and operationalization of Complex Integrated Systems, namely the new Information and Communication Technologies in Health.

In Portugal, some of the new technological challenges are already well known, as the recently implemented e-Prescription. Other technological innovations are already scheduled as, for example, the Health Data Platform. Despite the large number of challenges that the Portuguese Health Ministry faces in the ICT domain for the next two years, to which this project intends to answer, the internationalization of the partners' activity and the exportation of the products resulting from the project is their main goal.

With the Industrial Research and with the resulting innovation, SAL will design and develop products in four specific areas, namely, skin lesions risk evaluation and skin cancer prevention; healthcare for Melanoma patients, hemophiliacs and hypo coagulation patients; component for the blood chain at the national and regional level; and component for transfusion security and blood surveillance in hospital internal blood services.

The SAL project will be developed in partnership by Glintt HS S.A., by the Engineering Faculty of the University of Porto and by Associação Fraunhofer Portugal Research, through the integration of the competences of the three entities for the research, innovation and consequent design of New Technical Solutions for Health.

Partners: FEUP - Faculdade de Engenharia da Universidade do Porto; Glintt - Healthcare Solutions.

Outcome: The research results and Industrial Innovation that will result from SAL will be applied in the design and construction of marketable products, that answer the questions and challenges faced in the new paradigm in which the Citizen/End User/Patient has a central and active role in Health Management.

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: EFACEC - Engenharia e Sistemas, OPTIMUS - Comunicações.

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.

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ShopView 11

Description: Planning the shop layout is one of the most crucial tasks in the retail business nowadays. The right placement of products in a modern supermarket determines significantly the number of sold items. To maximize the overall income, supermarkets optimize the shelf layout and put products with a high profit margin on prominent places in the aisles. The manufactures of the products are willing to pay the supermarkets a so called shelf rent, in order influence the shop layout, to promote their own goods. The wrong placement of a product might therefore not only result in worse revenue, but also in contractual penalties. As the shop layout changes frequently, there is a permanent need for control which involves high costs since currently the task must be manually performed.

Partners: Modelo Continente Hipermercados; WeDo Consulting - Sistemas de Informação.

Outcome: The aim of the ShopView project is to automate the task of controlling the implementation of planograms, by creating a system which utilizes state of the art image processing technology to recognize misplaced products. The system will consist of a semi-automatic device to take images of the supermarket and software which performs the image processing and compares the real world data with the information stored in the planning software of the supermarket. The ShopView system will significantly decrease the rate of wrong product placements while decreasing costs of control at the same time.

SMARTSKINS – A novel framework for Supervised Mobile Assessment and Risk Triage of Skin lesions via Non-invasive Screening

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: Instituto Português de Oncologia – 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.

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.

EyeTracking4ALL – HCI Web platform to observation, analysis and evaluation of devices and ambiences

Description: This internal project developed a 'Human-Computer Interaction Lab', capable of systematize in a web platform Fraunhofer's HCI procedures regarding the observation, analysis and evaluation of all types of devices and ambiences.

Outcome: It is part of the Human-Computer Interaction research area and was a cross project with direct impact on current and future Fraunhofer products' quality. It is also expected the HCI Lab support the development of future certification test plans and the creation of services such as consultancy and certification at AAL4ALL (e.g., interface certification process). In addition, several Eye Tracking applications, such as gaze-based interaction, and Fusami tool (this, limited to apps evaluation) can be explored in future MSc/PhD thesis and possibly enable the creation of new projects and publishing of scientific articles.

FCCAlzNav 12

Description: AlzNav is a location monitoring, navigational and simplified calling application designed for older adults and people in the initial stages of dementia. It increases their autonomy by increasing their sense of safety when going outdoors and it also eases the caregivers' concerns by reassuring them that they will be alerted if a family member gets lost or needs help.

Currently it includes:

1. Monitoring and Alerts: If the user leaves a predetermined safety area (which is set and can be changed by the caregiver), the caregiver is alerted by an SMS that includes the user's current location, and the user is given the possibility to be guided back to a safe place or call for help;

2. Calling for Help: AlzNav enables users to perform one click calls to caregivers when necessary, and presents them with a simplified interface for calling other important contacts which can be chosen by the caregiver;

3. Remote Location Requests: Caregivers can remotely request information regarding their family members whereabouts when worried, through a simple SMS. These requests will be processed and answered autonomously by the application;

4. Navigation: A simplified navigational interface for its target user. An arrow that constantly points to the next waypoint, independently of the device's orientation, simplifies the navigational process, while also solving previous systems' issues regarding the initial orientation of the user. This component also supports a landmark assisted approach;

5. Support for specifying 'Points of Interest' for easy navigation (e.g. home, work, etc.) that can also generate automatic alerts when the user reaches or leaves them.

Outcome: Continue researching on this field and provide a prototype that consists of a smartphone application for the users and of a web portal for their caregivers. In this portal caregivers will be able to review all the information as well as configure the application remotely. The outcome prototype includes new functionalities such as the support for multiple complex shaped geofences, enabling caregivers to tailor the system's behaviour to their exact requirements. It also features state-of-the-art pattern recognition to assist the caregivers in understanding if relevant changes are occurring with their loved ones.

FCCBLES – BLE External Sensors

Description: Classic Bluetooth is a technology that provides a wireless link for local connectivity between two capable devices, for example a phone and a headset. The new specification, Bluetooth Low Energy, is intended for energy-constrained applications such as sensors because it was designed to enable wireless connectivity with small devices running on a coin cell battery. Since this is a new technology, the goal of this project is to understand the Bluetooth low energy technology and its

integration with mobile devices, by analysing the advantages and disadvantages of using this type of technology in the context of detection and prevention of falls, monitoring and Ambient Assisted Living.

Outcome: Evaluate the performance of the sensor Texas Instruments cc2541 (external sensor) by extracting the data from the various embedded sensors (temperature, humidity, pressure, gyroscope, accelerometer, magnetometer). Exploring the various software development kits available for android, namely the Bluetooth LE APIs from Samsung and HTC, as there is not currently an official BLE API from Google. This solution will be able to contribute to the improvement of detection systems and fall prevention, monitoring and Ambient Assisted Living by using Bluetooth LE external sensors as a complement to our current solutions.

FCCBLESv2 – BLE External Sensors v2

Description: Bluetooth Low Energy (BLE) technology brings to the scene the possibility to use wireless in very simple and inexpensive devices, such as the case when integrating sensors. The medical, healthcare and assisted living markets can utilize BLE to monitor vitals for the elderly or those with health ailments or diseases such as diabetes. Throughout the home or within an assisted living center, BLE can be used to enable novel sensor and actuator technologies that can transmit data back to a central monitoring station. This action can be accomplished through the existing cellular phones or Bluetooth-enabled PC infrastructure. Sensors would monitor blood pressure, real-time blood glucose levels, motion within the home, or the taking of medication. Actuators could dispense medication, issue reminders to exercise or wash, and open doors using secure identification via a watch or other wearable device.

BLE technology can also offer a low-cost, low-power interface to a cellular phone, laptop, or other Bluetooth-enabled products. Dual-mode BLE capabilities integrated into cell phones will allow for watches and other personal user identification (PUID) devices to manage cell phone functions. This includes using your watch to monitor caller ID, mute or ignore a call or to silence your ringer when your phone is in a hard to reach place. Proximity functionality designed into your BLE watch or cell phone will enable security and tracking capabilities beneficial across a range of markets. A BLE watch can be used to lock your laptop when you walk away and unlock the laptop when you return. Tagged items such as your wallet, car keys or even a child could be monitored so that a warning is issued as soon as these devices or people are 'out of range'.

Outcome: Combining the previous work done on the FCCBLES project with more stable future releases of the Android BLE API, this is the opportunity to contribute with applications that are more robust and more focused on the area of AAL, namely on the field of physical therapy and rehabilitation, home monitoring of older adults and subjects with chronic conditions (with the integration of wearable and ambient sensors), and also automatic monitoring of activities of daily living (ADLs, such as eating, drinking, cleaning, and so on).

FCCFAM – Falls and Activity Monitoring

Description: Falls are a major health risk that diminishes the quality of life among older people and increases the health services cost. With the increasing proportion of older people in population, this problem is becoming increasingly serious and the management of falls is becoming a challenge.

Therefore, this project aims to develop integrated solutions for activity monitoring, falls detection, fall risk prediction and security, targeting older people living in the community.

The first solution, called 'Mover', is able to track the physical activity level and help users to become more active through a social competitive network using a mobile phone. The information available through the smartphone's sensors is used to continuously monitor the movement and detect falls, earlier alerting their occurrence, and therefore enabling a faster assistance.

Additionally, based on movement characteristics, potential risk factors for falling can be identified. The smartphone based fall risk analysis tool allows to combine the use of the smartphone sensors, such as the accelerometer, to assess gait, balance and mobility problems, with medical questionnaires so that several risk factors for falling can be identified and monitored over time.

Outcome: The purposed smartphone-based solution aims to monitor different dimensions of risks over extended periods of time, including fear of falling, mobility and balance problems, reduced muscle strength and flexibility. This solution will be able to assist health care practitioners on tests execution, both at seniors home and clinical environments. Tests are also conceptualized as attractive serious games to be used independently by the elderly subjects without supervision.

Additionally, the activity monitoring component will enable an automatic classification of the activity the user is performing (e.g. walking, running, inactive, cycling, sitting, etc.), as well as a quantification of the energy expended, number of steps, distance covered, etc., which will motivate the person to maintain an active lifestyle, and simultaneously, provide insights into individuals' health and well-being.

Smartphones and/or external sensors will be explored as targets for the development of falls and activity monitoring solutions. The combination of activity monitoring, fall risk prediction and fall detection can be of great value for older people and society, in the context of fall prevention and security.

FCCKinteract – Motion Sensing for Natural User Interaction with Applications 13

Description: Kinteract is an application that basically focuses on using motion sensing technologies (like, for instance, Microsoft Kinect, Asus Xtion Pro or special sensors like Orbotix Sphero or Leap Motion) for detecting gestures and movements that are found to be intuitive in order to be used to control specific applications following the natural user interface paradigm. The research activities will focus on the development and fine-tuning of algorithms that can smoothly detect specific gestures and other body movements without the need for specific training by the user. Kinteract is being developed in the most generic way, so it can be used or integrated in many different scenarios, either when there is direct support for the sensor or not.

Kinteract was later adapted and used in the context of physical rehabilitation, where two rehabilitation games were developed, focusing on hemiparesis condition where the angles between the arm and forearm/torso are monitored to track the progress of the patient.

Future developments comprise improvements and new ideas more focused on virtual reality rehabilitation and therapy, using game concepts and targeting on elderly people and people who suffered strokes or other corticospinal injuries. The biggest advantage of the outcome of this project is that it will allow a close monitoring of the movements, angles, etc., sharing them to the therapist who can then track the progress of the patient.

This project is being developed in partnership with CRPG (Centro de Reabilitação Profissional de Gaia), who will help in providing new ideas, definition of requirements related to rehabilitation and with tests and validations with real users.

Outcome: A complete server that integrates several motion sensing devices (Microsoft Kinect/Asus Xtion Pro, Leap Motion, Orbotix Sphero, etc.) and provides unified data to applications. The client application being developed focuses on physical rehabilitation and provides several games that motivates that patient for the long process and can track patient evolution based on pre-defined metrics and provide all measured data to physicians.

FCCPIL – FCC Precision Indoor Location 14

Description: Indoor location systems are an important enabling technology for applications such as indoor navigation, public safety and security management, ambient intelligence, as well as provide huge potential around advertisement and retail businesses.

Because of the lack of reliable GPS signals inside buildings, the so-called pedestrian navigation systems (PNS) have been emerged as a solution for the indoor positioning unsolved problem. These systems rely on dead reckoning algorithms based on fused data provided by an Inertial Measurement Unit (IMU).

Since smartphones embrace always-on and sensor fusion was already a topic studied at Fraunhofer Portugal, under the scope of FCC, using these devices as IMUs seemed to be the obvious solution to achieve a highly accurate indoor location system at very low cost.

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Dead reckoning based on the fused data provided by IMU on the smartphones can then be used to evaluate one's current position by using a previously determined position. Location-based sensor fusion will become a standard feature in next generation smartphones.

Since dead reckoning is subject to cumulative errors, navigational aids are needed in order to give accurate information on position. This aided information can be gathered from any system that can provide reference points with increased resolution.

In order to evaluate the accuracy of this location-based sensor fusion, Fraunhofer Portugal approach relies on the Ultra Low Frequency Magnetic Communication system as a navigational aid. ULF-MC is a communication technology developed at Fraunhofer Portugal in 2012, that when combined with a last fix from a GNSS system will lead to absolute coordinates.

Fraunhofer AICOS is already in negotiations to license the technology on the international level, which includes a small patent family filling around this topic.

Outcome: This project will result in a service which maps navigational aids on a real-world indoor map model and project the path information, retrieved by the smartphone, over it.

FCCSAFETY – FCC Safety Application 15

Description: With this project we're expanding our work and knowledge into the area of safety and security. The work that is to be conducted is divided into several subfields:

1. FCC: Expanding the activity monitoring capabilities to include the detection of other relevant events in the safety context (e.g. path/route detection);

2. Backend Server: Creation of a backend server that is able to monitor all operatives, and send/receive data; This server will be able to present the information regarding the users in a single screen, delivering direct information regarding user states (OK, Alerts, etc.) on top of a custom designed interface;

3. Smartphone: The Operatives solution is centered on a vest-attachable smartphone. This unit has its camera pointing to the operative's front, enabling the video streaming of the operative's field-of-sight to the operations manager;

4. Head Mounted Display: When available, connecting a heads-up display unit to the smartphone will enable the operative to receive data straight in his line-of-sight. The viability of running the activity monitoring on this unit will also be evaluated in the course of this project.

Outcome: Development of a prototype system which includes a backend monitoring and control solution for Operation Managers, and a smartphone centered solution for Operatives. The prototype system will be able to let the managers track and monitor the operatives' location, state and activity at all times, as well as see what they see in real-time in emergency situations. The operatives will wear a fixed smartphone on a vest, which will be able to connect to a Head Mounted Display unit to enable communication with the Operation Manager, receiving data directly on their line-of-sight.

HFClinicInternal – Heart Failure Clinic (Internal) 16

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.

ICT4DccFUSAMI – Fraunhofer Usage Mining

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. It observes the user interaction in a real application and applies state of the art analytical algorithms to find and visualize 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: A system which can be easily integrated into nearly any existing Android application through a simple API that is able to collect and analyse usage data to find hidden patterns and provide insight into user's usage habits.

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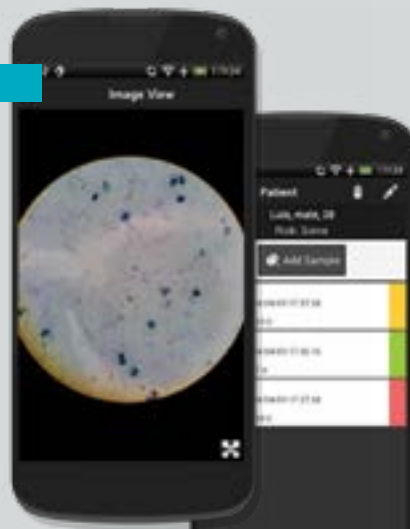
ICT4DCCMalariaScope – Digital Analysis of Malaria Infected Blood Smears via Mobile Devices **17**

Description: Malaria is one of the most severe public health problems worldwide, being the leading cause of death disease in many developing countries. In 2010 caused approximately 655,000 deaths, 91% of them in the African Region and mostly related with misdiagnosis or late diagnosis. Thus, there is an urgent need of new tools that can facilitate the rapid and easy diagnosis of malaria, especially in areas with limited access to quality healthcare services.

Outcome: This work aims to create a mobile-based framework that effectively improves the differential diagnosis of malaria in medically underserved areas. We intend to use the new generation of cellular phones in our system architecture, which exhibit significant improvements in terms of image acquisition and are becoming widespread worldwide, even in developing countries.

Melanoma Detection **18**

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.

OSMOS – Open Source Mobile Operating Systems

Description: This project aims to give support to the FhP R&D team in the area of Open Source Mobile Operating Systems (OSMOS). The main goal is to study all the advantages and disadvantages of the main well known OSMOS in the market.

List of Operating Systems intended to be studied: Android, Firefox OS, Ubuntu, Tizen, BlackBerry.

Outcome: The project will compare the benefits of 'betting' in each one of the OS at many levels (market share, manufacturers involved, OS maturity, ease of development, ROM changes support) and all this information will be written in a report that can be accessed by all FhP members.

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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.

User Network (Colaborar) 19

Description: The User Network aggregates a number of institutions, such as adult day-care centers 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 thirty-one institutions, including senior universities, adult day-care centers, living centers and healthcare institutions. So far, it has supported over 800 user research and testing activities.

ACADEMIC ACTIVITIES

Regarding academic activities, it is worth highlighting that the Director of Fraunhofer 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 Fraunhofer AICOS 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 AICOS.

Android-based implementation of Eulerian Video Magnification for vital signs monitoring

Eulerian Video Magnification is a recently presented method capable of revealing temporal variations in videos that are impossible to see with the naked eye. Using this method, it is possible to visualize the flow of blood as it fills the face. From its result, a person's heart rate is possible to be extracted.

This research work was developed at Fraunhofer Portugal and its goal is to test the feasibility of the implementation of the Eulerian Video Magnification method on smartphones by developing an Android application for monitoring vital signs based on the Eulerian Video Magnification method.

There has been some successful effort on the assessment of vital signs, such as, heart rate, and breathing rate, in a contact-free way using a web-camera and even a smartphone. However, since the Eulerian Video Magnification method was recently proposed, its implementation has not been tested in smartphones yet. Thus, the Eulerian Video Magnification method performance for colour amplification was optimized in order to execute on an Android device at a reasonable speed.

The Android application implemented includes features, such as, detection of a person's cardiac pulse, dealing with arte-facts' motion, and real-time display of the magnified blood flow. Then, the application measurements were evaluated through tests with several individuals and compared to the ones detected by the ViTrox application and to the readings of a sphygmomanometer.

Assisted Coding Technologies for International Classification of Diseases

Medical coding is a challenging job, performed by specialised coders and increasingly demanding given the current regulatory environment. Currently, and particularly in Portuguese hospitals, a great deal of human time and effort is expended in assigning codes to diseases and other health-related conditions described in medical records.

In order to assign codes to a medical record, the coder must read the content of each clinical document and select from thousands of codes the smallest set appropriate to a given situation. Since these codes determine mainly reimbursement, it is important to accomplish this task as accurately and as fast as possible.

This thesis presents a coding system capable of automatically process the content of the clinical reports, extract the clinical terms referred in the free-text clinical documents and map between these terms and the corresponding International Classification of Diseases 9th revision with clinical modification (ICD-9-CM) codes.

The developed coding system contains six main components: Document Pre-Processing; Document Reader; Natural Language Processing; Name Entity Recognition; ICD-9-CM Module; Assignment Code Result. This system is developed on top off the Unstructured Information Management Architecture (UIMA).

For the evaluation of the system, 22 clinical notes were created by two physicians specialised in cardiology. The results of the system indicate a precision of 96.81% on the extraction of clinical terms and a precision of 90.43% in the assignment of unique identifier to clinical term. The assignment of ICD-9-CM code was evaluated with a precision of 86.17%.

Behavioural Analytics for Medical Decision Support: Supporting dementia diagnosis through outlier detection

We live in a world that is ageing at a rapid pace and where life expectancy is growing. This is a phenomena commonly known as demographic change and has been a focus of various fields of study. With the number of elders rapidly increasing, their problems, in particular health related ones, are a major concern. As many of our elders live alone at their homes tracking their health and behaviours is essential to diagnose and address several health problems that may arise. Dementia is a syndrome that can be caused by several diseases being the most well-known Alzheimer's Disease. It is characterized by a progressive loss of cognitive abilities that ultimately lead to a complete dependence on others to carry out even the most basic tasks of everyday living. Although there is no known cure for dementia there are some treatments that have shown interesting results in retarding its evolution. But all the results that any treatment can get are greatly dependent on an as early as possible diagnose because treatments starting at later stages have little or no effect in stopping the progress of dementia.

The first symptoms of dementia are small changes and difficulties experienced by the elder person. Those details will easily go unnoticed by the elder, family members or other caregivers and may not be duly reported to the health professional that could give a diagnosis. Therefore it is important to find other ways of detecting those small changes. It is here where ubiquitous collection of data through the usage of sensors plays an important part. With a well-structured sensing platform it is possible to collect detailed information. But the information itself is not enough. Therefore that data needs to be treated and analysed in order to present pertinent information, that might be valuable to the diagnosis process.

This project proposes to design a system that receives information from various different sources and analyses that data to find possible dementia signs. But before trying to find these possible signs the system establishes the normal pattern of behaviour of a person as a baseline for future analysis. In order to find those signs of dementia, outlier detection techniques and algorithms are used during the analysis process. All the information that enters the system and resultant from its analysis is then stored to be available for consultation by health professionals, caregivers and elders. This information is then presented in a web visualization, that focuses in showing the information in a meaningful way, without any unnecessary and distracting elements.

The system was tested using real world data sets and data produced by Java programmes created specifically for each usage scenario. With the conducted tests was possible to see that this system is able to detect outliers in different types of data, after comparing the data that continuously arrived with the normal patterns established for a user. With these results it is possible to infer that such a system could be in fact a valuable tool in the diagnosis process of dementia and in monitoring its development as well.

Effective Scheduling of Energy Consumption in
Smart Grids

This research focuses on demand side management in Smart
Grids and the hypothesis of reducing peak demand using
Smart Grid capabilities.

Alongside with the production of electricity, concerns
related with the efficiency of production, distribution and
consumption of produced energy appeared. These concerns
arise from the willingness of producers to maximize profit and
environmental awareness, which is growing everyday in our
society.

Driven by that motivation, research in renewable energy
resources is increasingly augmenting and potentiating the ap-
pearance of new challenges in the production of these cleaner
energies, that in addition to be greener are also cheaper
in a long-term. One of the main challenges is powering all
demand with these energies. Renewable energy generators
have a long setup time and it proves to be difficult since in
peak situations, electricity delivery must be instantaneous,
making them dependent on faster delivery time petrol
generators to manage peak demands. Managing demand
peaks require control of consumer devices which can only
be possible nowadays using Smart Grid capabilities in order
to communicate with consuming devices. This approach also
demands a certain flexibility of users to postpone or anticipate
appliance executions, having as counterpart cheaper energy
prices in certain times of the day.

In this research is assumed that electricity prices are known
24 hours in advance, making it possible to schedule home
appliances operation. Therefore, using communication abilities
of a Smart Grid and electricity prices, this research sets as a
main goal to develop an algorithm that can schedule devices
in order to help reduce peak demand. This scheduling is
constrained by user input, indicating the time frame within
which each schedulable device must execute.

The resulting scheduling algorithm is based on a meta-heu-
ristic called Evolutionary Algorithms, which uses as a solving
technique as a metaphor of human evolution, by trying to
mimic crossover between individuals and possible mutations
that also happened during human evolution. This method al-
lows finding very good solutions within a reasonable amount
of time, making it feasible for a real-world operation. Results
are obtained within milliseconds, which for human perception
is almost instantaneous.

All goals proposed in this master thesis were successfully
completed. Results are promising in terms of employing the
proposed algorithm in the production phase of its parent
project.

Generic and Parameterizable Service for Remote Configuration of Mobile Phones Using Near Field Communication 20

Mobile services have increased both in number and complexity in the past few years. This means that in order to get the most out of these services, less experienced users will have a hard time configuring them by hand. To address this issue, we must find new and innovative solutions to assist the user in this process. Furthermore, we live in a society of the immediate: everyone wants access to resources to be fast, simple and secure. It is also known that most of the users are laymen when referring to advanced configuration of mobile phone, resulting in some inertia in the use of applications and functionalities.

The survey of the State-of-the-Art in this field shows that currently there is no complete solution to this problem. However, the related work shows that some of the problems are already being addressed and that with Near Field Communication it is possible to develop new solutions, successfully reducing user intervention.

Near Field Communication (NFC) provides an unique opportunity to introduce new business paradigms in terms of interaction and ease of use. This technology allows short-range communications between NFC-enabled devices by simply holding them near each other, typically with minimal user intervention.

What mechanisms can one use to minimise an user's effort to configure his mobile device? What technologies are available that cope with this problem? How can one leverage them? What mechanisms can be used to ensure their security? How could service providers take advantage of such service? This dissertation provides an answer for these questions by proposing an architecture that defines a new logic layer that can be used by vendors and developers to configure applications and the mobile phone itself. It supports multiple location-based service configurations, with or without authentication, for different users. The proof-of-concept prototypes show promising results, allowing multiple services to be configured simultaneously and effortlessly.

Improving geolocation by combining GPS with Image Analysis

In recent years, geolocation technologies have evolved so fast, that today almost every technological mobile device can be traceable through a simple internet connection. A few years ago, geolocation system was almost another term for Global Positioning System (GPS) receivers, because that was almost the only known technology of that kind. With the technological evolution over the years, new geolocation technologies emerged, and the existing ones became more accurate, accessible and portable. Today it is possible to find cheaper GPS Navigation Systems, and much more accurate and faster than a decade ago. Most smartphones already have an incorporated GPS receiver, sometimes combined with network data, and web browsers can already track (even though with low accuracy) the actual location of some IP address.

Despite all this evolution, geolocation by GPS can fail, due to lack of visibility to the satellites: without direct view from the receiver to a set of at least 4 satellites is not possible to correctly execute the necessary triangulation. To resolve this problem, GPS might be combined with network information (A-GPS), which allows a faster triangulation and an accurate response.

Given this context, this dissertation follows an innovative approach in geolocation that combines GPS information with a computer vision component. The main goal is to demonstrate that geolocation can sometimes be more accurate with the help of an image analysis system, which adds value to the coordinates read from the GPS by reducing the error through an identification of georeferencial entities in captured frames.

With this approach, it would be possible for a device to know its relative position, even in locations where the GPS information is not available, fixing some known problems like the positioning inside Urban Canyons, where the GPS information is unavailable for moments leaving geolocation softwares with no clue about their position.

To demonstrate the validity of this concept a prototype was implemented and used for a series of tests. This prototype consists in an application aimed for public transports, developed for Fraunhofer AICOS, institution focused in the improvement and usability of the information and communication technologies (ICT), mainly of the senior population, with application in mobility. The implemented prototype has the goal to improve the visibility of a public transport passenger to the exterior of the vehicle, using a mobile application that reproduces the exterior landscape, signalling a sequence of points of interest (POI) and adding textual information about that POI to the image.

With the help of computer vision, the lack of geolocation may be compensated and, as can be seen in the evaluation chapter, the system, if able to, know its location even when GPS information lacks or is outdated.

Interoperable Assistive Technologies

The increasing number of elderly citizens in our society puts an increasing strain on traditional healthcare systems' resources. Ambient Assisted Living (AAL) solutions seek to reduce the impact of this tendency as well as provide a way for the elderly to continue to live in their home environment as long as possible with a good quality of life and independence. However, due to the diverse nature of existing products and services, ensuring interoperability between them is important in order to provide flexible and adequate solutions for an individual's particular needs.

The goal of this dissertation is to present a possible solution for this problem using Electronic Health Records (EHRs) and health information standards. For this purpose a repository was implemented to store records in Extensible Markup Language (XML) format following the openEHR standard, as well as an application in the Java programming language to create, manage and query these records in the repository and an interface engine (Mirth Connect) was used to provide message transformation capabilities implemented in JavaScript between different standards, particularly Health Level Seven version 2.x (HL7 v2.x) and openEHR.

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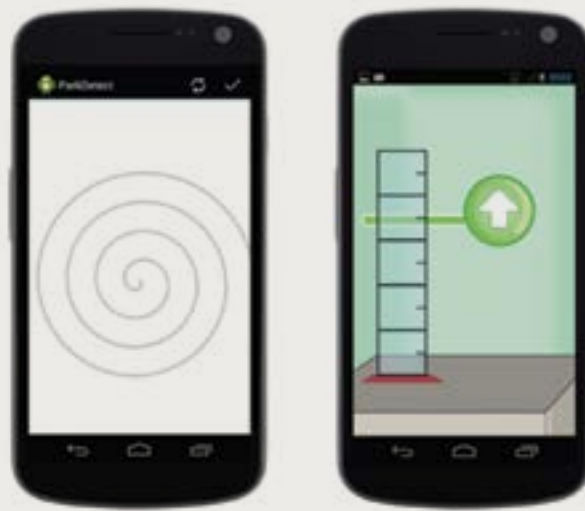
Multi Person Tracking in Real-time Video Stream

The goal of this project was to demonstrate how it is possible to combine a video based object tracking system with a robotic device which moves, with some degree of precision, according to the movement of the tracked object. More specifically, a person-tracking system was developed which analyses video captured by a Pan-Tilt-Zoom (PTZ) camera to estimate a target person's movement relative to that camera. Those detected movements are then translated to commands which are sent to operate the robotic device.

Accurately tracking people, or any object, in real-world scenarios is still an open computer vision problem, and a challenging one. For the scope of this project, the approach was to use the tools provided by the OpenCV computer vision library to be able to track a target person up to some degree of sudden changes in movement direction, occlusions and ambient light conditions. These are the main real-world parameters which affect object tracking.

As a robotic device, a moving light with 2 Degrees of Freedom (Pan and Tilt) was used as a proof of concept. This robotic light can be controlled through its DMX input interface, an industry standard for lighting control. For the integration of this DMX interface with the controlling computer, we have used an Arduino Uno board fitted together with an Arduino DMX Shield which acts as a bridge and converts the commands sent by the computer to DMX signals.

With this system we are able to light the way for a moving person, although not without limitations. The off-the-shelf robotic light was obviously not developed for this purpose, so its movement commands do not allow enough granularity for the accuracy of this type of application and also its reaction time to commands is not very fast.

ParkDetect – Early Diagnosing Parkinson's Disease **21**

Parkinson's disease is one of the most common neurodegenerative disorders of the central nervous system that affects elderly. There are four main symptoms: tremors, rigidity, bradykinesia (slow movements) and posture instability. Nowadays any type of diagnose for this disorder is done through observation by a health care professional specialised in this area. Therefore it is necessary a method that is simple and efficient for health care professionals of general clinic to use so they can have some grounded backup to decide to forward a possible patient to a specialist. In this context a mobile application where a health care professional can insert values about possible patient's symptoms or the patient himself can realize small test is an interesting challenge due to reach they have today.

This project can be split in three important phases:(1) development of a smartphone application, (2) use it to gather data from real patients and a control group and (3) testing and selection of a classification algorithm (selecting the relevant data and compare different algorithms) to be inserted in the same application.

The first phase was the one with the most research since it was needed to understand how the symptoms could be detected only using the smartphone components and develop/adapt the application. The second one was the most time consuming, lasting from after the application getting developed to almost the end of the available time due to delays from the medical institution and the lack of capable patients that could perform the tests. The final one was highly affected with the lack of available data, making properly grounded conclusions impossible, however it was possible to obtain some promising results from the gait analysis of the patients where the pelvic sway was a good feature to help differentiate Parkinson patients from healthy ones.

Personal Medical Advisor 22

Healthcare faces new challenges with automated medical support systems and artificial intelligence applications for personal care. The incidence of chronic diseases is increasing and monitoring patients in a home environment is inevitable. Heart failure is a chronic syndrome and a leading cause of death and hospital readmission on developed countries. As it has no cure, patients will have to follow strict medication plans for the rest of their lives. Non-compliance with prescribed medication regimens is a major concern, especially among older people. Thus, conversational systems will be very helpful in managing medication and increasing adherence.

The Personal Medication Advisor aims to be a conversational assistant, capable of interacting with the user through spoken natural language to help him manage information about his prescribed medicines. This patient centered approach to personal healthcare will improve treatment quality and efficacy. System architecture encompassed the development of three modules: a language parser, a dialog manager and a language generator, integrated with already existing tools for speech recognition and synthesis. All these modules work together and interact with the user through an Android application.

System evaluation was performed through a usability test to assess feasibility, coherence and naturalness of the Personal Medication Advisor. It was concluded that the developed assistant could successfully make users achieve their objectives. In addition, the system was evaluated as easy to use, coherent and with a pleasant interface. Further improvements can still be done to extend the flexibility and convenience of the Personal Medication Advisor so that an easy integration on senior patient's daily life can be achieved.

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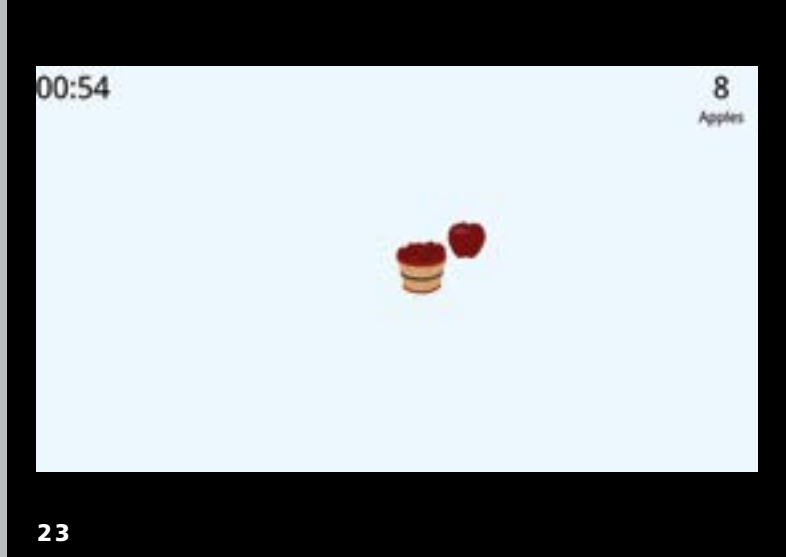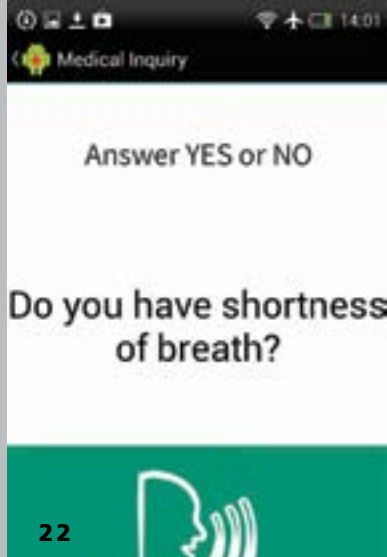
PhysicTV – Motion-based physical rehabilitation games for GoogleTV 23

Rehabilitation and physiotherapy sessions are essential to treat injuries and regain some basic movements that were performed without limitations before the injury. Traditionally those sessions take place in a clinic or health center and involve repeating movements that exercise the part of the body under treatment. The constant repetition of these movements tend to make the sessions less innovative and dynamic, which leads to the loss of interest of the patient who is injured, and in addition is in a heavy and discouraging environment. These factors can lead to an increased demotivation throughout the rehabilitation process causing patients a willingness to finish the session and go home, without having in mind if their evolutionary process is going well.

So, the inclusion of the developed electronic games that include movements normally used in physical therapy can be seen as an extra factor of motivation, allowing the patient to face his rehabilitation process in a different way and making sessions more dynamic and positive, which leads to the satisfaction of both physiotherapist and patient. The development of a system that supports these games, composed by a motion sensor, a GoogleTV and a television, also allowed the implementation of a method to capture the angles made by the user when performing movements, so the physiotherapist can evaluate the evolution of his patient. Thus, the system can be seen as a complement for the physiotherapist mission of helping the patients recover and evaluating them.

In order to make all of this possible there was an accompaniment of the physiotherapis when making a survey of requirements about movements and their evaluation measures, so the games could be subsequently created and developed to be used in a professional context as the final testing phase proved.

QuadAALper – Adapting Quadcopters to Real-Life AAL Application Scenarios using Smartphones

Quadcopters are interesting pieces of engineering, accessible to the general public since the introduction of RC and small-scale UAV models. Since then, major developments regarding size, stability, autonomy, control, Artificial Intelligence, HW and SW development tools, etc., have been introduced by academia and enthusiasts.

Nevertheless, the vast majority of the application purposes given to these machines still fall into the recreational scope. Recently, some have tried to exploit more 'useful' purposes for these machines, e.g. a brain-controlled quadcopter for the disabled, a quadcopter tower-building task force or surveillance tasks.

The goal of this thesis is to study the applicability of quadcopters to AAL scenarios and exploring its further integration with smartphones (or a dedicated system running Android) and taking simple actions based on the recognition of simple image patterns.
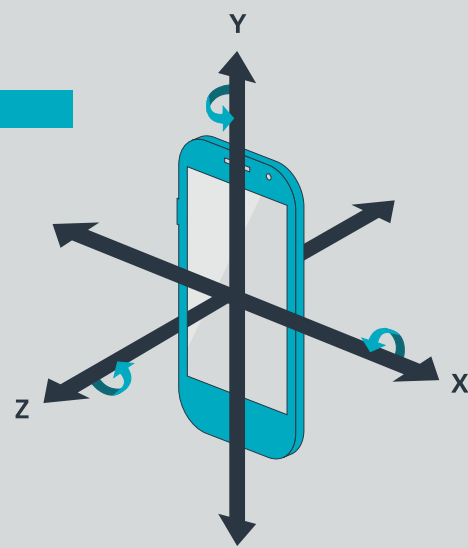
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Sensors on Mobile Devices for AAL 24

With the ageing of the population and the concerns about the people's well-being increasing, new tools need to be developed in order to allow the permanent monitoring of this demographic group. The use of smartphones by elders can be crucial in their well-being and autonomy since they are a lot of times equipped with sensors that can provide caregivers with precious indications about the caretaker current status.

Sensors can provide data about the patient's physical activity, as well as detecting falls or calculate its position, with the help of the accelerometer, the gyroscope or the magnetic field sensor. But functionalities as these require, mandatorily, a minimum sampling frequency from the sensors that will allow the implementation of algorithms that will determine those parameters in the most exact way possible.

Having in mind that the caretakers often are not accompanied by their smartphone when they are at their home places, the creation of AAL environments with the help of some other external devices that can be 'worn' by the patients might also become an adequate solution. These devices normally contain the same sensors as the smartphones and communicate with them through wireless technologies, like Bluetooth Low Energy.

This work evaluates the possibility of sensor frequency modification in several Operating Systems, and some modifications in the source code of some open source systems were performed. With the objective of allowing the creation of an AAL solution using an external device, profiles and services were implemented on an external device, the SensorTag.

Smartphone Based Fall Prevention Exercises 25

Falls are one of the greatest problems facing ageing and older people. Due to age-related changes and frailty, individuals may unintentionally lose balance or stability while performing activities of daily living, even without any external cause. Loss of muscle mass, slowed pace of movement, decreased activity and some weight loss are just some of the factors that may lead to a fall. In such advanced ages, a fall may lead to serious individual problems, such as loss of confidence, fear of falling again and loss of independence.

Exercise programmes focusing on muscle strengthening and balance retraining can be effective as part of a fall prevention approach in both community and residential aged care settings. Exercise will affect not only physiologic variables (e.g. flexibility, balance, endurance, coordination) but also psychological variables, such as anxiety or depression. Home-based programmes and group programmes must therefore be challenging yet safe, and additionally they must provide the required enjoyment and enthusiasm to be performed with the desired frequency to be effective.

Currently, multiple ICT-based solutions for falls prevention exist. However, most of these solutions do not focus in reducing specific fall risk factors like muscle mass loss or poor balance.

The proposed fall prevention solution is based on an existing home based moderate intensity fall prevention programme developed by Prof. C. Melo, which targets the Portuguese population. This exercise programme is focused on specific fall risk factors, including lower limb strength, balance, muscle endurance, flexibility and voluntary stepping.
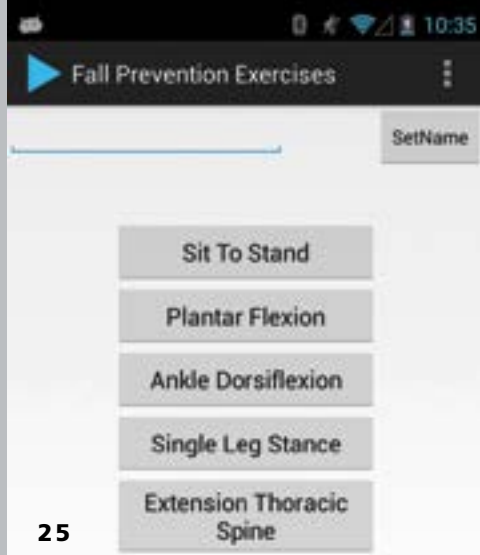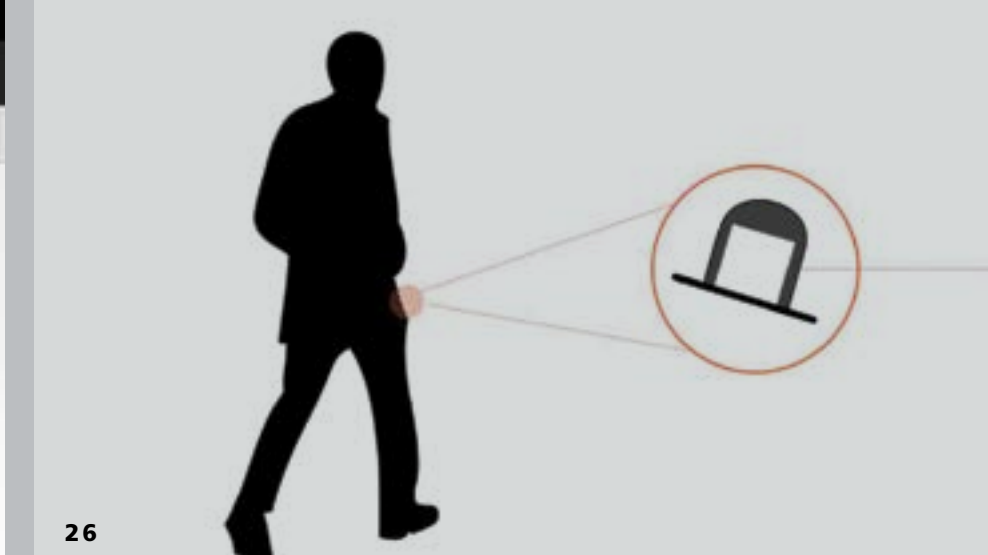
25   **26**

Therefore, and taking advantage of the smartphone processing capabilities as well as of the inertial and position sensors built-in the smartphone (magnetic sensor, gyroscope and accelerometer), a solution was developed to support the execution and evaluate specific fall prevention exercises. The smartphone can be a friendly and inexpensive solution capable of increasing seniors' adherence to fall prevention exercises as well as raise their motivation to properly execute the exercises. The results achieved in this dissertation suggest that the use of portable devices like a smartphone to evaluate and support the execution of fall prevention exercises can be of great value for older adults. In the future, exercises can be adapted to serious games, therefore increasing the motivation required to perform the exercises regularly.

Smartphone Based Human Activity Prediction 26

Human physical activity monitoring has received an increasing interest by elders' caregivers, athletes, physicians, nutritionists, physiotherapists and even people who want to check the daily activity level.

Concerning applications for elderly, and taking into account the actual increasing of aging population and decreasing social and economic conditions for elderly daily care, telecare systems have emerging and have been considered as a solution for some of these problems.

In this project it will be described how to extract human postures, postural transitions and walking patterns from motion data recording with Smartphone built-in accelerometer, particularly a tri-axial sensor. The application of this system is to supervisor elderly or physical active people who are interesting in checking or improve their physical level.

Methods to monitor activities of daily living, as standing, sitting, lying, walking and climbing stairs, were proposed based on a dataset composed of ten 60-70 years subjects, five male and five female, who carried a Smartphone placed longitudinally on their waist. The threshold-based approach implemented was capable of discriminating between static and dynamic activities. Static activities refer to situations when the user is static in a posture, as standing, sitting or lying; dynamic activities refer to activities that involve movement of the user, as walking, climbing stairs and transitions between postures (sit-to-stand movements). Within static activities, the angle between the user initial position and the orientation during each movement was used to differentiate the user postural orientation. The analysis of walking patterns were conducted in the frequency domain using Fast Fourier Transform and analysing the peak in the correspondent spectrum with higher amplitude, which corresponds to the step rate.

The problem of discriminating activities can be treated as a classification problem using techniques of machine learning. Using a public dataset provided by SmartLab during the ESANN competition, it was possible to study the more suitable metrics to extract from acceleration signals in order to train and test a classifier. Using a decision tree classifier, which was implemented with J48 algorithm from Weka, it was possible to achieve 86% accuracy and a 14% classifier error for the train and test datasets provided in the competition.

The results obtained suggest that accelerometer sensors could be used for accurate physical activity detection and strategies to implement the classification algorithms in Android environment should be implemented.

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Smartphone Based Tele-Rehabilitation **27**

Cardiovascular diseases are very punishing to their victims. Stroke survivors have to adapt their routines to the partial or total loss of control over one or more parts of their bodies. That lack of control can go from the lack of sensibility, to locomotion problems and to the lack of proprioception, i.e. to the loss of the sense of orientation of limbs in space.

To overcome some of the difficulties caused by the disease, patients have to undergo physiotherapy. The routine of rehabilitation that is typically applied can become tedious, re-petitive and not motivational and requires travelling to a heath care facility, which contributes to an increased emotional ex-haustion. If physiotherapy could be carried out in the comfort of home, with appealing exercises that would motivate the patients, they would likely show a better emotional response and an increased commitment in recovery.

The growing dissemination of smartphones made the concept of smartphone based tele-rehabilitation possible. Tele-rehabilitation is the rehabilitation that is carried out by patients without the physical presence of a therapist. The later receives feedback of the progress of patients remotely. In the most industrially developed countries, almost everyone owns a smartphone and Android is the most widely employed mobile operating system. Besides that, these devices are equipped with sensors with high capabilities that can be used to evaluate training exercises.

This thesis explored the concept of a cheap alternative to the traditional methods, that can be both motivational and intuitive and that allows patients, in a more advanced phase of recovery, to carry out their physiotherapy at home, or wherever they feel more comfortable. The developed application provides intuitive and appealing games that can be used for rehabilitation purposes. To play the games, patients have to attach the smartphone to their forearm and allow the application to connect to a desktop/laptop via Bluetooth. The games' visual interface is displayed in the laptop/desktop monitor, providing an intuitive experience and an improved visual feedback. A pre-calibration phase ensures that all games are adapted to each individual patient's impairments so that the games' difficulty level is adapted to each patient needs. Movements performed during game execution are evaluated and the maximum range of movement achieved by patients is recorded for a proper physiotherapeutic evaluation.

Smartphone Gesture Learning

Smartphone capabilities have been increasing in the last years, and many applications have been developed in order to take advantage of these capabilities. Smartphone users, knowing that there are lots of applications to ease many daily tasks, or simply to have some fun, typically have the smartphone close by. One of the capabilities that have been explored is the detection of the physical state of the smartphone, through inertial sensors embedded in the smartphone. The smartphone can detect its own orientation and even detect if it is being moved through sensors like the accelerometer, linear acceleration sensor or the gyroscope.

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Given that the smartphone can detect its own physical state and the fact that users often have their smartphone close by, the opportunity of developing a new natural and intuitive way of interacting with the smartphone arises, and this opportunity is related with gestures. Using the embedded accelerometer, linear acceleration sensor or gyroscope, the smartphone can detect if the user made some movement with the hand that is holding the smartphone. The objective of this Dissertation is to develop a software framework to be used in Android applications to render the applications capable of detecting gestures performed by its users as means of interaction, sparing an Android developer the effort of implementing such functionality. The idea is to include a pre-trained set of gestures in the framework that developers can use but also be able to automatically learn new gestures through repetitive training.

The gesture recognition capability is carried out by a Hidden Markov model approach, in a user independent setting, and it was achieved an average recognition accuracy of 97.8% using the gyroscope and the linear acceleration sensor on an alphabet of 8 gestures, and an average accuracy of 85.1% using the accelerometer and the gyroscope on an alphabet of 24 gestures. Smartphone gesture recognition has been used in several research areas, as health care, monitoring systems, or user commodity. One Android application using this framework could be used, for instance, to remotely control an electronic device, or trigger an action in the smartphone. Given the promising results that have been achieved, the next steps in terms of future work concern exploiting the developed framework in the development of a real application, taking advantage of this new interface for user interaction.

STAlz – remotely supporting the diagnosis, tracking and rehabilitation of patients with Alzheimer's 28

The ever increasing quality in health care led to an impressive improvement of the life expectancy rate in the last decades, which results in an increase in the number of elderly people. Of the diseases associated with aging, Alzheimer's Disease (AD) is one of the most prevalent, representing a rate of up to 80% of all the dementia cases. Due to its symptoms (memory loss, mood changes, disorientation to space, time and people, among others) the disease represents a heavy burden to the patient, the caregiver and the health care system. This comes to show that solutions addressing this topic and that try to improve the current way of tackling the disease are urgent and necessary.

The research on the state of the art regarding the current way of handling the disease showed that difficulties exist: in obtaining information from the patient periodically; in being able to support the rehabilitation of the patient in a remote environment; in establishing a more permanent contact with the caregiver regarding important events that happen to the patient and can change the disease's progress rate; and, lastly, in having an easy and intuitive way of analysing the disease's progress.

This dissertation addresses these issues by proposing a system capable of: providing the health care professionals with data gathered periodically from the caregiver and the patient; increasing the proximity between the caregiver and the health care professionals; allowing the patient to perform cognitive stimulation exercises in a remote offline environment; and supporting the analysis of the disease's progress by the health care professionals.

For the system to be useful, it needed to be designed with its target group in mind. Thereby interfaces were designed according to the existing guidelines when developing for older adults and more specifically, older adults with dementia. These were tested and tuned according to the feedback of the actors relevant to the system (health care professionals, caregivers and patients).

The feedback received from the health care professionals and caregivers regarding the system's usefulness and usability is positive, and the results obtained through the testing of the system are promising.

User-Driven Design, Development and Evaluation of a Tablet-Based Cognitive Gaming Platform for Seniors

Population ageing is becoming more of a reality as time goes by. The percentage of seniors in the overall population is growing each year and it is only believed to grow even more in the next years. Associated with ageing are several age-related changes that can affect seniors both physically as well as cognitively which, if ignored, can impose serious threats in their quality of life and selfesteem.

Digital games are believed to hold the potential to stimulate the brain and help reduce and even stop the natural decline of cognitive abilities. However, the way that technology is designed and implemented does not favours the needs and goals of the senior population. As such, their receptivity towards computers, and consequently digital games is very low, as they have difficulties understanding the benefits that such systems can bring. However, in the last few years, new types of devices possessing more intuitive ways of interaction such as tablets and smartphones have emerged, which can be a new opportunity to change the way seniors perceive technology.

The primary goal of this project is to design, develop and evaluate a tablet-based gaming platform with its target audience being the senior population. The games provided by the gaming platform have the objective of stimulating various areas of the cognitive domain in order to help maintain, or even increase, the mental capabilities of the senior players contributing to an improved overall well-being. In addition, the game platform also aims at promoting social interaction between seniors by means of group play activities and game results sharing using a ranking mechanism.

To achieve these goals, we start by performing a study of the specific characteristics of the senior user as well as what makes a game appealing to the player, and why the tablet proves to be an advantageous device to our target audience. With the results of our research we develop a solution that incorporates cognitive and social mechanisms into its games, while performing iterative evaluations together with the final user by adopting a user-centered design methodology. In each design phase a pre-selected group of senior participants experiments with the game platform and provides feedback to improve its features and usability. Through a series of short-term and long-term evaluations the game platform proves to be appealing to its intended users providing good usability and an enjoyable gaming experience.
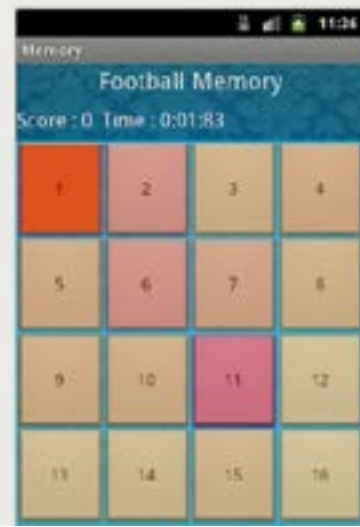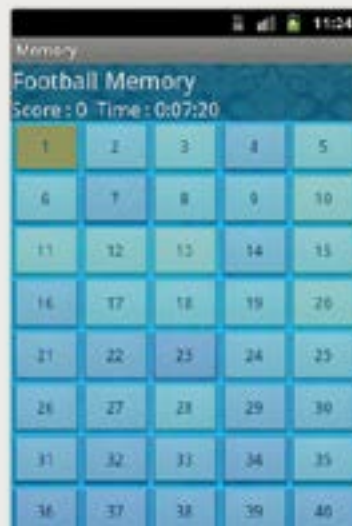
Visual Prototyping Tool for Android and iOS

The ubiquity of smartphones in our lives has generated a booming market for mobile cell phone applications. This rapid expansion has created an increasing need for the development of functional prototypes for these applications that mimic, as accurately as possible, the behaviour of the final product, in order to be able to perform usability tests.

This poses a problem, as the general lack of technical skills of the usability experts, who usually design these prototypes, conflicts with the need of writing code to produce prototypes that have complex functionalities. On top of this, the usually used tools to perform this kind of tasks often possess, themselves, major usability flaws.

Our proposed solution for this problem is twofold. On the one hand, we will develop a tool that allows HCI experts to visually develop complex prototypes with advanced back end functionality that minimises the need of writing code. On the other hand, we will try to make this tool as usable as possible, by performing a four-stage study of the most popular approaches to several design environment problems that allows us to create a new design methodology for these kinds of cases.

To sum up, we propose to create a tool that enables HCI specialists with minimal technical skills to quickly, efficiently and cheaply develop high quality functional mobile prototypes.

Visualization of Complex Data – The case study of FUSAMI 29

With the proliferation of access to the internet, humankind produces and consumes more information than at any other time in its history. The type of data produced ranges from simple pieces of text, to images, video, temporal or geospatial information, among others.

Visualizations try to answer this issue, allowing the understanding and the exploration of large datasets. A good visualization goes beyond the mere static display of information, becoming also the interface with which the user interacts to navigate the data and answering his questions.
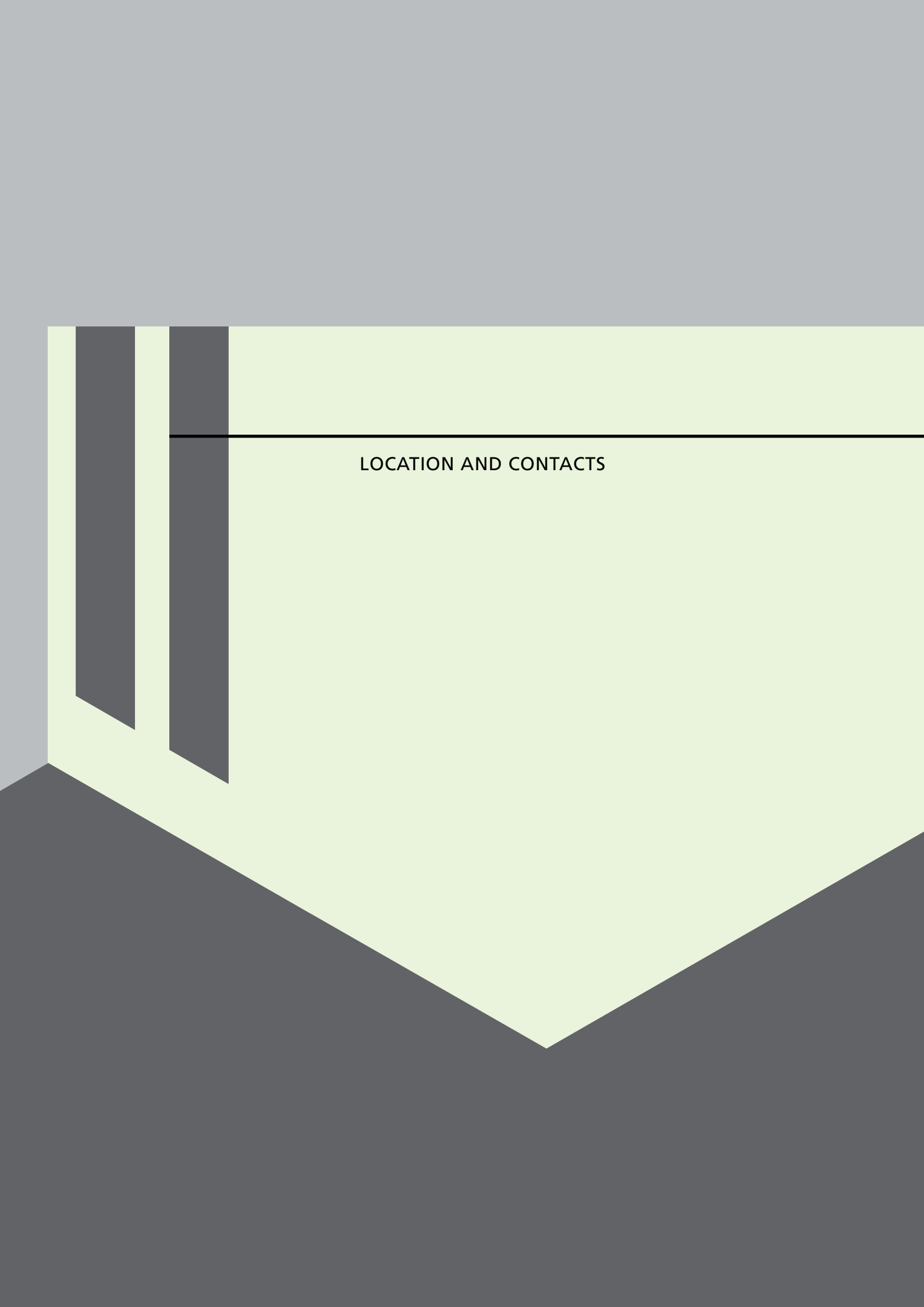
The Web Browser has also become the primary window of a user to produce and consume data, being present in every desktop or mobile device with access to the Internet. Mobile Internet usage has surged in the past few years and continues to do so and in the short term will surpass desktop usage.

But no longer previously widely used graphic technologies to build visualizations, such as Flash or Java, can be used to produce visualizations that can be viewed in every device, as those technologies are not ubiquitous in mobile devices. In spite of this unavailability the emergence of HTML5, and other graphic technologies, supported in almost every recent browser, provides an alternative for building visualizations.

The analysis of data can be helpful in many fields, especially analytics and in this thesis we aim to present a case study, FUSAMI, in the area of analytics of usage of mobile phone applications on how they may be visualized to build better applications, by taking into account the real interaction of the user.

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