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ARMOR project

Epilepsy is the commonest serious brain disorder, affecting up to 1% of the population worldwide.

The ARMOR project will combine clinical and basic neuroscience research with advanced data analysis, medical management tools and to develop novel applications for the management of epilepsy.

ARMOR will design a more holistic, personalized, medically efficient and economical monitoring system for people with epilepsy. The system will provide a flexible monitoring capability optimized for each patient and it will be tested in several case studies and evaluated as a wide use ambulatory monitoring tool for efficient diagnosis and management of seizures including possibilities for detecting premonitory signs and feedback to the patient.

In this project we will manage and analyze a large number of data from brain and body activities of epileptic patients and controls. New methods and tools will be developed for multi-modal data pre-processing and fusion, real-time

and offline data mining to discover patterns and associations. This system will incorporate models derived from data analysis based on existing communication platform solutions emphasizing on security issues and required adaptations to meet ARMOR specifications.

Expected Results

Increase our understanding of Epileptic seizures and eventually epilepsy; Other non-epileptic paroxysmal events (NEPE) and their underlying mechanisms; Relationship between epilepsies and various types of NEPE; Macro- and micro-structure of sleep and the general state of vigilance.

Advance novel holistic monitoring and analysis approach by combining feasibility with advanced data analysis, medical management tools and telecommunication.

Guidance of diagnostic workout before treatment and accurate assessment of treatment response.

Detect life threatening seizures by acquiring relevant data at individual level and at the patient's home so that seizures could be prevented from occurring by intervening in the person's immediate environment.

ARMOR consortium

The ARMOR consortium consists of a combination between ICT and Medical partners. It is a multidisciplinary consortium, with representatives from the value chain of SME companies (M2M, telecommunications, services and products of Brain Dynamics) and R&D providers,

together with Medical experts and end user representative, has the complementary expertise necessary to successfully develop an accurate diagnosis, monitoring and analysis for epileptic. ARMOR brings together experienced European researchers in epilepsy and other brain disorders (AAISCS, UoP, KCL). Together with partners such as S&C, ICOM, KIT and STMA which have previously demonstrated their ability to integrate different sensors data and ICT solutions into commercialised products, ARMOR has the critical mass necessary to achieve success.

Partners like UoP and TMES have long experience of testing and development algorithms for data encryption and multiparametric analysis from medical data.

**Sensing&Control
Systems S.L.**



**Technological Educational
Institute of Mesolonghi**



**AAI Scientific Cultural
Services Ltd, Lab. For
Human Brain Dynamics**



**SYSTEMA
Technologies S.A.**



**Karlsruher Institut
für Technologie (KIT)**



University of Patras



**St Thomas' Hospital, Kings
College, London**



**INTRACOM S.A. Telecom
Solutions**



ARMOR events

Alberto Fernandez on behalf of, project coordinator Narcís Avellana, opened the meeting by welcoming all. All participants introduced themselves. A review of the administrative and technical objectives was done. The kick-off meeting was held in [Nicosia \(Cyprus\)](#), 21st-23th November 2011.



1st Technical meeting was held in [Patras \(Greece\)](#) 8th-9th March, 2012. It was organized by UoP with the aim to consolidate concepts between the technical Work Packages (sensors, middleware, algorithms...)



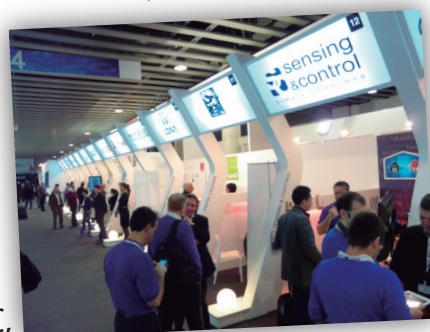
The ARMOR project was presented in the last Mobile World Congress (MWC) held in **Barcelona** the last **25th-28th of February 2013**. There different promotion material was distributed by S&C that had a stand where their products were presented to the audience including technologies that are being used within the ARMOR project. The MWC was an excellent opportunity to understand which is the state of the art concerning eHealth mobile devices and applications, as well as,



which could be the approach for the exploitation plan.

Narcís Avellana, coordinator from S&C,

opened the second general meeting by welcoming all. The meeting was organized at **London 4th-5th of December 2012** by the KCL, giving the opportunity to the partners to visit St. Thomas Hospital, where most of the patients helping in ARMOR are treated.



Dissemination events

Workshop	Location	Date	Participants	Topic
1st Joint Cypriot-Greek-Russian Epilepsy Workshop	Nicosia, Cyprus	February 14th - 15th, 2012	UoP	Presentation of the ARMOR
IEEE International Conference on Multisensor Fusion and Information Integration	Hamburg, Germany	September 13th - 15th, 2012	S&C	Workshop: New Multi-Sensor Devices for Remote Management of Disease

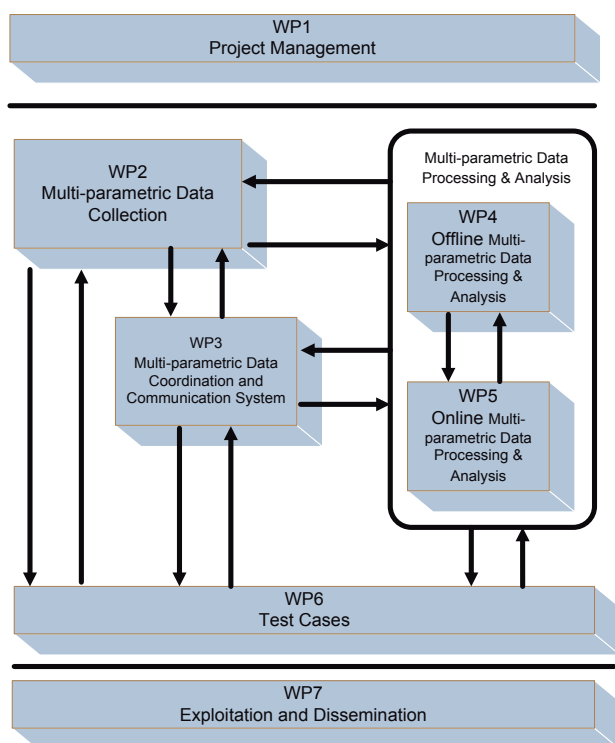
Conference	Location	Date	Participants	Topic
8th FENS Forum of Neuroscience	Barcelona, Spain	July 14 th - 18 th , 2012	UoP	Distributed ARMOR fliers
Michael Forum and 50th anniversary of Michael Stiftung für Epilepsy	Berlin, Germany	October 5 th - 6 th , 2012	UoP	Understanding sleep mechanisms contributes to a redefinition of the term "generalized" of absence seizures
Conference on Systems Neuroscience and Rehabilitation	Tokorozawa, Japan	March 14th-15th, 2012	AAISCS	Dissemination of publicity material and discussions for ARMOR
SIAM International Conference on Data Mining	Anaheim, California, USA	April 26 th , 2012	UoP	ARMOR fliers were distributed
10 th European Conference of Epileptology	London, UK	September 30 th - October 4 th , 2012	UoP	Member of the International Organizing Committee of the 10th ECE informed several of its members about the ARMOR project

Trade shows	Location	Date	Participants	Topic
MEDICA 2012 International trade fair	Düsseldorf, Germany	November 15th – 17th	KIT	Presentation of the ARMOR

Publication	Location	Date	Participants	Title
Proceedings of 5th Fifth IEEE International Workshop on Selected Topics in Wireless and Mobile computing	Barcelona, Spain	October 8th - 10th, 2012	TMES	The Effect of Symmetric Block Ciphers on WSN Performance and Behavior
Proceedings of 3rd International Conference on Wireless Mobile Communication and Healthcare	Paris, France	November 21st - 23rd, 2012	TMES, KIT	Mobile Multi-parametric Sensor System for Diagnosis of Epilepsy and Brain Related Disorders
Chapter in book, Advances in Clinical Neurophysiology, Ihsan M. Ajeena (Ed.), ISBN: 978-953-51-0806-1, InTech	-	June 10th - 14th, 2012	AAISCS, UoP	Sleep spindles – As a Biomarker of Brain and Plasticity

Technical outcomes:

An overview of the work plan and interaction between the various work packages.

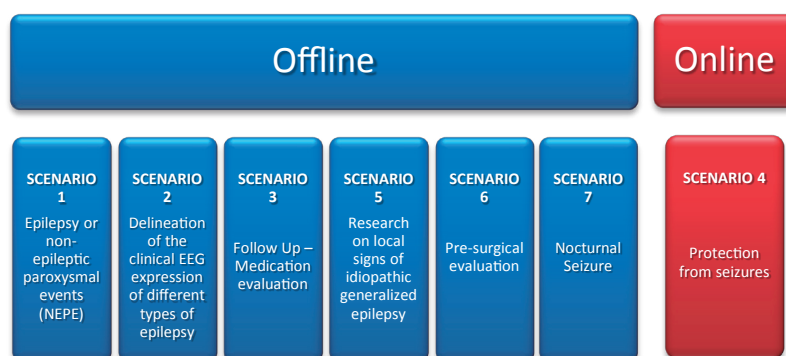


WP2 results

Requirements of the ARMOR Services:

- Exploration of needs for the support of Epilepsy Diagnosis.

- Analysis of functional and non-functional specifications of existing platforms.
- Comprehensive analysis of 7 possible scenarios of usage.



Data Acquisition

Prospective data collection – 21 EEG channels, respiration, ECG, pulse oximetry (plethysmography), EMG, O2 sat, eye movements. These data have been collected:

- 10 patients with IGE
- 10 patients with focal epilepsy
- 10 with non-E paroxysmal events (4 with PNES; 5 with SD; 1 with VV)

ARMOR sensors and middleware

- Definition of the most efficient and beneficial sensors for recording all required physiological data.
- Adaptation of existing sensors platforms
- Development and implementation of HW security algorithms for guaranteeing the privacy and security of patient's data
- Development of procedures to collect real time data from sensors
- Definition of middleware components / interfaces

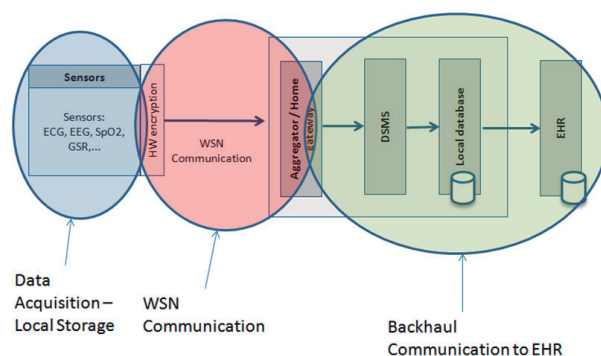


<http://www.movisens.com>

<http://xaffect.org/>

<http://www.biosignalsplux.com/>

- Research on respective technical measures against attacks



End-to-end security infrastructure configuration

- Study Enhance Communication Infrastructure wrt to security provision and Communication Performance (Figure 1):
 - o Design of the ARMOR HW Encryption module;
 - o Enhancements of EHR communication capabilities wrt to security provision;
 - o Enhancement of the ARMOR sensors' functionality wrt to security provision
- Definition of ARMOR Data Management Processes

WP3 results

Data Privacy and Security requirements

- Study of the ARMOR system requirements focusing on
 - o Data protection and privacy;
 - o Practice guidelines.
- Creation of ARMOR security and privacy checklist
- Risk analysis of the ARMOR system considering all aspects and/or component as depicted in the Figure below.

Encryption Module Block Metrics:

- Ultra low power
 - o Power dissipation in the range of 6 to 11 mWatts
- Adequate performance
 - o >37Mbps for Xilinx Spartan-3 technology 200MHz
- Compact Implementation
 - o Highly competitive silicon area requirements

Partner News:

AAISCS

AAI Scientific Cultural Services Ltd. (AAISCS, <http://www.aaiscs.com/>) is a private research enterprise specialising in basic and applied neuroscience. Its current main goal is to translate findings from basic neuroscience to practical applications that enhance human mental health and well-being.



Recently, AAISCS has successfully concluded a project aimed at developing a prototype system for mass screening of children four to eight years of age for learning difficulties, and especially Developmental Dyslexia. The current goal is to move from the proof-of-principle prototype to a fully functional product that can routinely be used at homes, in kindergartens and schools for early detection and diagnoses of learning difficulties in young children.



AAISCS has also started provision of new services through its newly established department of Cyprus Neurofeedback Centre. Such services include comprehensive evaluation of brain condition through one-to-one interviews, Continuous Performance Test and quantitative EEG, and neurofeedback training programs for specific conditions (e.g. ADHD, anxiety, etc.), general relaxation and peak performance.

In 2012, AAISCS has organized two events: an international conference on Child Development and Dyslexia (<http://www.aaiscs.com/dyslexia/>) and a one-day event for general public publicising the research.

KIT

The Institute for Information Processing Technology (Institut für Technik der Informationsverarbeitung, ITIV) is one out of thirteen laboratories of the Department of Electrical Engineering and Information Technology of the Karlsruhe Institute of Technology (KIT). The Microsystems Technologies and Optics group is currently the largest research group of the institute. The group covers a broad area of research topics in the fields of sensors, bio-medical systems and mobile long term health monitoring.



Recently KIT received the funding for creating the Karlsruhe Decision and Design Laboratory (KD2Lab), funded by the German Research Foundation (DFG). This will consist of 40 cabins equipped with mobile devices for monitoring all the main bio-signals such as electroencephalography (EEG), electrocardiography (ECG), electromyography (EMG), and galvanic skin response (GSR).

The lab will enable the further development of algorithms for the psychophysiological monitoring as well as the development of procedures for the acquisition of cognitive and emotional states of test subjects and the analysis of the influence of these states on human decision making in different laboratory environments and decision-making situations.