ARMOR

Advanced Multi-parametric Monitoring and Analysis for Diagnosis and Optimal Management of Epilepsy and related Brain Disorders

ARMOR is an ambulatory, non-intrusive personal health system to address the needs of people with epilepsy and healthcare professionals by providing accurate diagnosis, monitoring and analysis.

Objectives of the project

Epilepsy is the commonest serious brain disorder, affecting 1-2% of general population, especially in childhood and adolescence. Epileptic seizures, manifest with a wide range of paroxysmal recurring motor, cognitive, affective, autonomic symptoms and EEG changes. Their recognition and full understanding is the basis of their optimal management. The yield of epilepsy diagnosis is considered unsatisfactory, as seizures occur unpredictably and typically outside hospital.

ARMOR will analyse data for the purpose of prediction, description and classification of seizures

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

- A non-intrusive personal health system (PHS) to address the needs of people with epilepsy and healthcare professionals by providing accurate diagnosis, monitoring and analysis.
- Differential Diagnosis of seizures (is it epilepsy or non-epileptic paroxysmal event?)
- Delineation of the clinical EEG expression of different types of epilepsy
- Localized signs in childhood idiopathic generalized epilepsy
- Seizures dependence on the level of arousal
- Pre-surgical evaluation of intractable seizures.

Project Description

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.

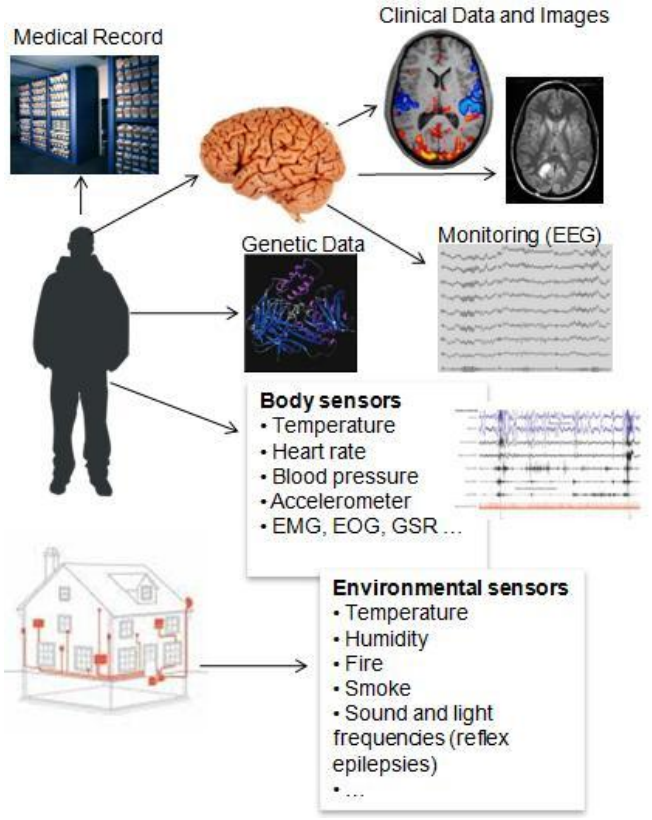
Reliable diagnosis requires state of the art monitoring and communication technologies providing real-time, accurate and continuous brain and body **multiparametric data measurements**, suited to the patient's medical condition and normal environment and facing issues of patient and data security, integrity and privacy. In this project we will manage and analyse a large number of already acquired and new multimodal and advanced technology data from brain and body activities of epileptic patients and controls. New methods and tools will be developed for multimodal data pre-processing and fusion, real-time and offline data mining of multi-parametric streaming and archived data to discover patterns and associations between external indicators and mental states, lag correlation detection, identification of motifs or outliers, automatic summarization of results, and efficient medical context data management. This system will incorporate models derived from data analysis based on already existing communication platform solutions emphasising on security issues and required adaptations to meet ARMOR specifications. Special effort will be devoted in areas such as data anonymization and required service provision

Case study or Practical Example or Scenario

John is a 27 year old civil servant who has been suffering from episodes of panic since the age of 14 when he was extremely stressed in his boarding school. He reported a sudden feeling of anxiety, and palpitations, while his girlfriend described that he would go pale and sweaty with dilated pupils, and on occasions he would faint. These episodes occurred randomly but also after stress. A diagnosis of epilepsy was initially considered, but the symptoms were highly atypical, his routine and sleep EEG and brain MRI were normal while a 10-days video telemetry as inpatient did not capture any event. ECG, echocardiography, exercise test and Holter for 48 hours were normal, while continuous loop monitoring captured only one episode of tachycardia that was not deemed causal. Tilt table test and several autonomic tests at a tertiary center were unremarkable. He had psychiatric treatment for 7 years. He lost his job but never stopped driving. At the age of 24 years he was monitored at home with an ambulatory personal health system. Habitual attacks were analyzed on line and were identified as epileptic seizures manifested with potentially life threatening autonomic symptoms. The patient was treated with antiepileptic medication and has been seizure-free for three years. He has a new job, drives safely and is no longer at risk of sudden death in epilepsy.

Expected Results & Impacts & Preliminary results

- Increase our understanding of
  1. The epileptic seizure and eventually of epilepsy;
  2. The other non-epileptic paroxysmal events (NEPE) and their underlying mechanisms;
  3. The relationship between epilepsies and the various types of NEPE;
  4. The macro- and micro-structure of sleep and the general state of vigilance.
- Advance a novel holistic monitoring and analysis approach by combining feasibility with advanced data analysis, telecommunication and medical management tools:
  1. Multi-parametric data acquisition, processing, management and analysis;
  2. Development of the information coordination and communication support system providing efficient data communication and feedback.
- Guide further diagnostic workout including imaging studies, specific screening and genetic testing, delineation of baseline state before treatment and accurate assessment of the treatment response, and guidance of further diagnostic workout with a view towards epilepsy surgery if medical treatment fails.
- 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.



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- AAI Scientific Cultural Services Ltd (Cyprus)
- INTRACOM S.A. Telecom Solutions (Greece)
- SYSTEMA Technologies S.A. (Greece)
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Biomedical sensors, Electronic health records, Personalised health, Medical imaging processing and analysis, Security and privacy, Signal processing, Wearable medical systems