

Project profile

CSI

Central nervous system imaging



Sub Programme

- Nanoelectronics for Health and Wellness

Diseases affecting the brain and the central nervous system are among those with the greatest impact on our society. The ENIAC JU project CSI aims to advance the state of the art in three-dimensional (3D) medical-imaging platforms to improve the efficiency of the diagnosis and therapy of these serious diseases. The objective of the project is to develop an innovative yet simple and low-cost smart 3D imaging system suitable for use in ambulatory or domestic settings, able to enhance early diagnostic accuracy and boost the prevention capability while reducing the total cost of the equipment.

The unavoidable process of the ageing of the European population imposes challenging demands on diagnostic medicine, requiring comprehensive technology support in the diagnosis and therapy of central nervous system diseases, ranging from degenerative brain disorders, such as Alzheimer's and Parkinson's diseases, to vascular problems such as strokes.

Central nervous system diseases are becoming much more prevalent as a consequence of modern medicine's success in increasing human life expectancy. Prevention and early diagnosis are very effective, but the equipment and procedures employed are currently too expensive for general application. In fact, these serious illnesses call for the most expensive diagnostic and therapy procedures available in western countries – often more costly than those used in the analysis of cardiac diseases.

The way ahead

Minimally-invasive computer-based imaging technologies such as posi-

tron emission tomography (PET), magnetic resonance imaging (MRI) and electroencephalography (EEG) provide for the monitoring and tracking of these illnesses while determining the strategy and effectiveness of the prescribed therapies.

The ENIAC JU project CSI will pursue the simultaneous capture and extraction of data produced by new-generation imaging devices to provide the best correlated information to the doctor through innovative and intelligent merging of both EEG timing and PET spatial resolution.

This combined, synergistic approach can only be made possible through advances in various technology fields that include sensors, integrated equipment and systems for data fusion and novel data-processing platforms that support teraflop-range computing capability directly in the doctor's office. Overall, the ENIAC JU project will anticipate new trends in the improvement of the support and treatment of central nervous system diseases at much lower cost.

Realistic enhancements

CSI will address some of the most appealing downstream technologies for 3D functional brain imaging, while focusing on realistic enhancement and super integration to achieve high-quality delivery at significantly reduced overall cost of patient management.

The primary objectives are:

- Demonstration of a novel class of PET solid-state sensors and architecture to replace and enhance old and extremely bulky photomultiplier tubes. This approach will lead to simpler, smaller and cheaper equipment with better performance in terms of sensitivity and signal-to-noise ratio, while improving overall reliability;
- Demonstration of system concepts for miniaturised electronics in local and targeted radio frequency (RF) excitation and signal reception in MRI applications;
- Demonstration of 3D functional brain imaging based on active electrodes combining EEG and electrical impedance tomography signal acquisition, with improved support for precise localisation of the signal source compared with existing source-localisation methods;
- Demonstration of structured data flow allowing the information produced by each medical-imaging mode to be shared and combined to improve the overall diagnostic picture of the central nervous system. The use of 3D should increase the accuracy of the geometrical information by more than 10% depending on the resolution and size of the objects. This would, in

turn, allow for the tailoring and optimisation of some mode-specific processing;

- Demonstration of a signal-processing platform based on commodity components able to provide teraflop-level performance in the doctor's office to support the visualisation algorithms required by previous technologies; and
- Clinical application of the new sensors and equipment with emphasis on demonstration of the suitability of the platform for use in non-hospital settings.

While each of the proposed objectives aims to improve the state-of-the-art in many situations, the main goals are cost reduction and quality enhancement by comparison with existing solutions, as well as novel features specifically conceived for functional 3D brain imaging.

European leadership

There are several global challenges and trends currently affecting the healthcare domain. Global economic growth has produced a higher spending on health, access to healthcare for a larger population and increased awareness of available healthcare options to the patient. Additionally, the wider access to healthcare policy has reached large developing countries such as China and India, where there is a dramatic growth in healthcare demand.

It is therefore anticipated that the successful outcome of the objectives of the CSI project will place Europe in the forefront of early diagnosis of age-related diseases and bring major benefits to European society.

Nanoelectronics for Health and Wellness

Partners:

- AIT Austrian Institute of Technology
- ATOMKI Institute of Nuclear Research
- austriamicrosystems
- GTech
- IMEC Netherlands
- Kempenhaeghe
- Mediso Medical Equipment Developing and Service
- Mat-Tech
- Philips Applied Technologies
- Philips Healthcare
- Politecnico di Torino
- STMicroelectronics
- University of Bologna, Alma Mater Studiorum
- University of Debrecen, Institute of Nuclear Medicine
- University of Pannonia

Project co-ordinator:

- Roberto Zafalon, STMicroelectronics

Key project dates:

- Start: March 2010
- Finish: February 2013

Countries involved:

- Austria
- Hungary
- Italy
- The Netherlands

Total budget:

- €14.64 million



The ENIAC Joint Undertaking, set up in February 2008, co-ordinates European nanoelectronics research activities through competitive calls for proposals. It takes public-private partnerships to the next level, bringing together the ENIAC member states, the European Commission and AENEAS, the association of R&D actors in this field, to foster growth and reinforce sustainable European competitiveness.