Microsystems and Smart Integrated Systems: A key enabling technology for AAL

Dr Andreas Lymberis
andreas.lymberis@ec.europa.eu

Information Society Technologies and Media, Micro-systems
European Commission, Brussels

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1. Smart Systems: Definition and Technological Aspects

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From the Past to the Future: from Microsystems to Smart Systems

Microsystems…

are miniaturised devices combining

- **sensing**
- **signal processing**
- **actuation**

through monolithic or hybrid integration.

Smart Systems is not Electronics !

Smart Systems…

- **are able to describe a situation and diagnose it,**
- **are predictive,**
- **are able to decide or help to decide,**
- **enable the product to interact with the environment.**

They are as small as possible, networked & energy autonomous

Smart implant

Smart RFID

Smart tire

2. Applications -> Functionalities -> Heterogeneous Tech Integration

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Microsystems is an enabling technology, bringing together separate technologies and sciences

- **Inter-disciplinarity**

Mechanics, electronics, fluidics, biology, magnetism, optics, photonics, chemistry,

- **Convergence of heterogeneous technologies**

Micro/nanotechnologies, ICT, bioengineering

- **Heterogeneous Materials**

Semiconductors, ceramic, glass, organics and polymers, metals

- **Multiple functionalities**

Sensing, processing, actuating, energy harvesting and storage, communication, memory, logic

Applications

- ***Biomedical***
- ***Transport***
- ***Telecommunications***
- ***Automotive***
- ***Safety***
- ***Environment***
- ***Smart textiles***
- ***Conformab***
- ***Flexible Syst***

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Application Fields of Smart Systems vs Key Functions

	Medtech & Healthcare	Internet of Things	Telco	Security	Aeronautics	Automotive
Energy Conversion		Green ICT	Green ICT		All Electric Plane	Hybrid & Electrical Vehicle
Smart Power Management	Wireless Implants & Autarktic Sensors	Wireless Sensor Networks	Power Management			Wireless Sensor for Smart Road
Chemical & biological sensing	Point of Care Systems Breath Analysis			NRBCE Detection	Cabin Air Quality	Power Train Control, Air Quality Monitoring
Conformable Flexible Systems (OLAE)	Disposable Band Aids & Tests	Low Cost RFID	Low Cost Antenna Systems	Smart Cloths	Maintenance Fleets	Instrument cluster & Energy scavenging
Smart Textiles and Foils	Smart Clothes, Home Monitoring			First responder Safety		
Vision Systems	Sensors for fluorescence, 3D vision		Imager for Mobile phone	All in one Camera		Pedestrian Detection

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3. Cluster of Activities Relevant to AAL: MNBS (Micro Nano Bio systems), SFIT (Smart Fabrics & Interactive Textiles)

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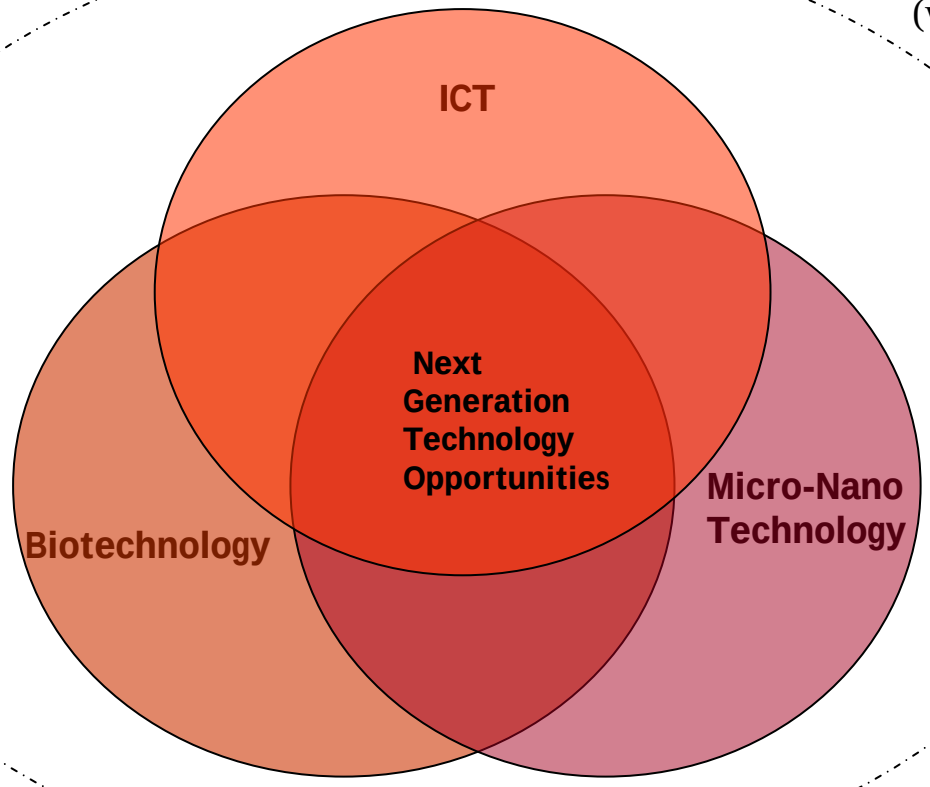
Converging MicroNano- Bio-ICT Systems

Highly Interdisciplinary

System miniaturization
(wearability, implantability)
High volume/low cost production



New or increased functionality
(DNA, protein, cell detection)

Medical research
& Unprecedented possibilities

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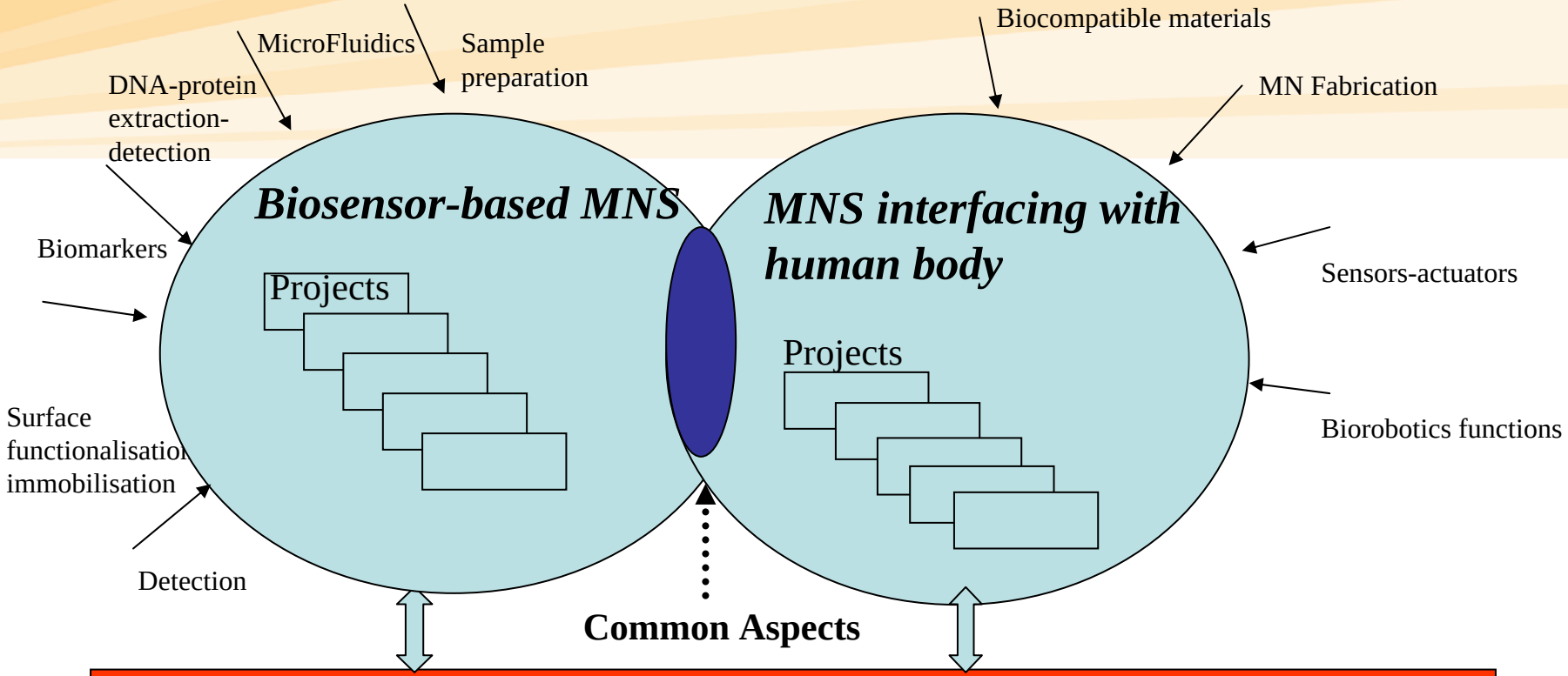
MNBS group Projects: Structure, links and content



Power, Signal Processing, Telecoms, Packaging, Manufacturing, Standardization, Ethics, Testing-Validation, Business, IPR, Certification, Dissemination, Awareness, Education.

- **36 Projects, 2 Service Actions**
- **145 M€, 390 Organisations, 27 MS & AS + China, Australia, USA, Korea, Mexico**
- **80 Universities, 60 R&D Centers & Institutes, 85 companies (Research & product development)**

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Technological and Application Areas Focus

Biosensors & Lab on Chip Components and Systems, e.g.:

DNA & protein arrays, LoC (e.g. MNT, surface chemistry, biomarkers, microfluidics, modelling, instrumentation, sample preparation, detection, integration/packaging and cost reduction)

Smart Micro Nano Systems on & inside the body, e.g.:

BioMEMS, BioRobots, Actuator-Sensor ("closed loop" systems), Drug delivery systems, Biochemical Wearable Sensing and Active low power implants

Business and driving forces, e.g.:

Driving applications: Healthcare/biomedicine, food, environment, security, leisure

Mass production (cost), user needs, ethical and societal issues.

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Smart Fabrics and Interactive Textiles (SFIT): Driven by the e-textile vision

Full integration of sensing, processing, actuating, communicating and power sourcing functions in a woven (or hybrid) structure.

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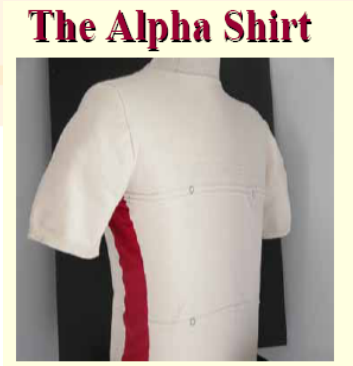
Recent R&D in Smart textile and garments



2000

2005

2008

Towards full integration of sensors, actuators, telecom & power

Wearable sensors/computing

- Developing & testing yarns as sensors and electrodes
- Knitted integrated connections to measure resistance values in the same fabric
- Testing for several biophysical and mechanical parameters
- Piezoresistive fabrics → First integrated prototypes

Research on new materials for active functions and integration with patches/textile

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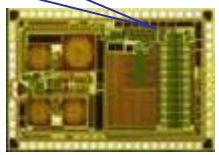
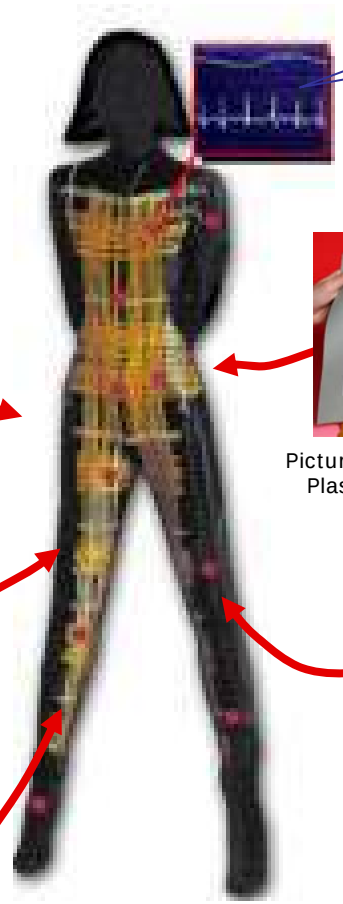
Development & Integration of innovative sensing, MNT, textile and ICT towards functionalised Smart Fabrics and Interactive Textile

Micro-communicating: sensor interface, processing and wireless

Microsystems physical sensors (attitude, fall, health, …)

Flexible displays

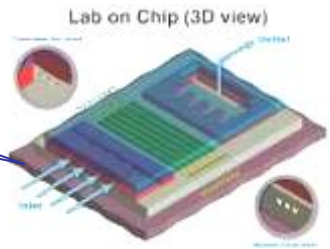




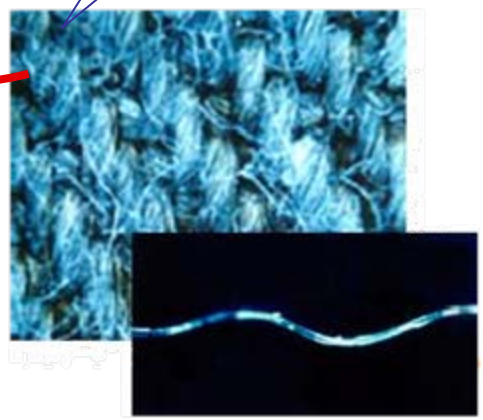
Picture: Courtesy of Plastic Logic Ltd

- Nanoengineered surfaces
- Conductive fabrics
- Micro-interfaces

Point of care



Micro-energy generators



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An (expandable) group (7 Projects, 40 M€ Funding)

www.csem.ch/sfit

PROETEX: Protection e-Textiles: MicroNanostructured fibre systems for Emergency-Disaster Wear, (1/02/2006 - 31/1/2010)

STELLA: Stretchable Electronics for Large Area Applications (1/1/2006 – 31/1/ 2010)

BIOTEX: Bio-Sensing Textiles to Support Health Management (1/7/2006-29/05/2008)

CONTEXT: Contact less sensors for body monitoring incorporated in textiles, (1/01/2006-30/6/2008)

MyHeart: Fighting cardio-vascular diseases by preventive lifestyle & early diagnosis, (1/12/2003-30/8/2008)

OFSETH: Optical Fibre Sensors Embedded into technical Textile for Healthcare, (1/3/2006- 30/9/2009)

SYSTEX (FP7): enhancing the breakthrough of intelligent textile systems, Coordinated Action (1/5/08-30/4/2010)

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4. Running AAL projects (from FP6 Call 6)

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SIXTH FRAMEWORK PROGRAMME
PRIORITY 2.6.2
INFORMATION SOCIETY TECHNOLOGIES (IST)
AMBIENT ASSISTED LIVING (AAL) IN THE AGEING SOCIETY

SPECIFIC TARGETED RESEARCH PROJECT

Project acronym:

SENSACTION-AAL

Project full title:

SENSing and ACTION to support mobility in Ambient Assisted Living

Contract no.: 045622

Start date: January 1st 2007

Scientific Coordinator: Lorenzo Chiari – DEIS – Università di Bologna (I)

lchiari@deis.unibo.it

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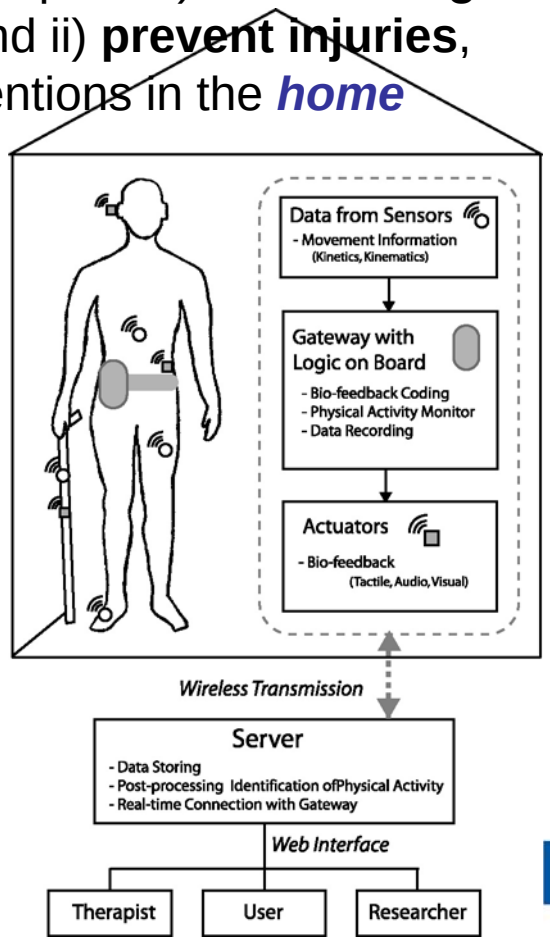
Project objective(s)

General goal of the project

The ultimate goal of the project is to assist older people in i) **maintaining independent mobility** and **daily life activities,** and ii) **prevent injuries**, by allowing medical professionals to initiate interventions in the ***home environment***.

The project objective

The consortium will contribute to this goal by: *developing, testing, validating, and making ready for the market*, a **body area networked system for mobility monitoring and conditioning**, where network nodes incorporate miniaturized **sensors and actuators**.



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Sixth Framework Programme

Information Society Technologies

Ambient Assisted Living for the Aging Society

Contract number: 045508

A NETworked multisensor system for elderly people: health CARe, safety and and securITY in home environment

Acronym: **NETCARITY**

Integrated Project

3. Future Call 5 for proposals under FP7

Opening in July 31st and closing in November 3rd

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Call 5/ ICT-2009.3.9: Microsystems and Smart Miniaturised Systems

(I) Heterogeneous Integration (IP, STREP)

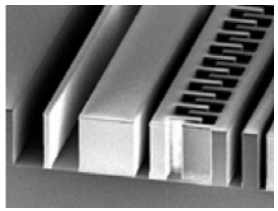
- Innovative concepts of industrial relevance
- Technological challenges that limit industrial take-up

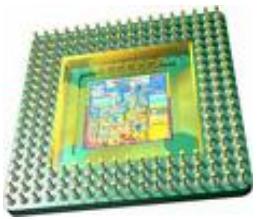
(II) Autonomous energy efficient smart systems (STREP)

- energy challenge
- communication challenge

(III) Application specific microsystems and smart miniaturised systems (IP, STREP)

1) **Biomedical** 2) telecommunications, 3) environment and food/beverage, 4) transport-safety and security, 5) **smart fabrics and interactive textiles**





European Technology Platform on Smart Systems Integration-EPoSS: Key Priorities and R&D focus :

Long term

EPoSS Joint Initiative

Smart Systems for Sustainable Mobility

Clean & Full-Electric Car, All-Electric Aircraft, Energy Efficiency

Smart Systems for Ambient Intelligence

Internet of Things, Future Communication & Networking

Smart Systems for Health

Health Monitoring and Control, Artificial Organs, More Comfort for the Patient

Smart Systems for Safety & Security

Chemical, Biological, Radioactive, Nuclear & Explosives Detection

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- European research on the web:
  - http://cordis.europa.eu/fp7/home_en.html
  - http://ec.europa.eu/comm/research/future/
- Information Society and Media:
  - http://cordis.europa.eu/fp7/ict/programme/home_en.html
- Directorate G:
  - http://cordis.europa.eu/fp7/ict/programme/challenge3_en.html
- Challenge ICT-2007.3.9:
  Microsystems and Smart Miniaturised Systems :
  http://cordis.europa.eu/fp7/ict/micro-nanosystems/home_en.html
- Challenge ICT-2007.3.2:
  Organic and large-area electronics, visualisation & display systems :
  http://cordis.europa.eu/fp7/ict/organic-elec-visual-display/home_en.html

Contact:
andreas.lymberis@ec.europa.eu

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