Wireless sensor network applications

Christine Azevedo Coste[1]

[1]INRIA DEMAR/LIRMM Montpellier
mailto:Christine.Azevedo@inria.fr

Workshop AEN PAL
INRIA Sophia Antipolis – Méditerranée

Outline

- **Context**

- **SensLAB platform**

- **SensTOOLS ADT**

- **SensAS ADT**

The Promise of Sensor Networks

- ▶ **Dense monitoring & analysis of complex phenomena over large regions of space for long periods**

- ▶ Many sensing devices (*small, inexpensive*)
- ▶ Frequent sampling over long durations
- ▶ Non-perturbing
- ▶ Compute, communicate, and coordinate
- ▶ Many sensory modes and vantage points

- ▶ **Close to the physical phenomena of interest**
- ▶ **Observe complex interactions**

Embedded Networked Sensing

Many critical issues facing science, government:

- ▶ The public call for high fidelity and real time observations of the physical world

- ▶ Networks of smart, wireless sensors can reveal the previously unobservable

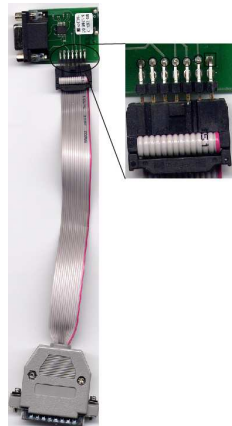- ▶ Designing physically-coupled, robust, scalable, distributed-systems is challenging

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Sensor Network Tesbed is a real nightmare

Real hardware is a nightmare

▶ Sensors are small devices
▶ Very limited interface capacities (debugging/programming interface)
▶ Software deployment, node re-programming, and debugging done by JTAG;
▶ Dedicated PC and individual manipulation of sensor nodes.
▶ Sensors are generally powered by a battery
▶ Human interventions
▶ Time consuming, error prone and not really gratifying.

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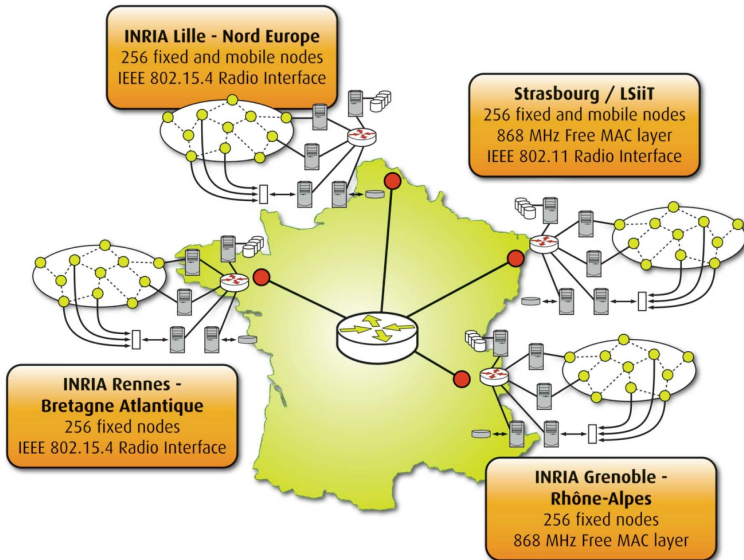
- **SensAS ADT**

SensLAB ANR

SensLAB project (2007-2011) objective was to deploy a very large scale open wireless sensor network platform. SensLAB's main goal was to offer a tool to help in the design, development, tuning, and experimentation of real large-scale sensor network applications. The SensLAB platform is distributed among 4 sites and is composed of 1,024 nodes. Each location hosts 256 sensor nodes with specific characteristics. The 4 test beds are part of a common global testbed as several nodes have global connectivity in order to experiment applications on all 1K sensors at the same time.

Consortium:

- ▶ LIP6, Paris
- ▶ INRIA (DNET, ASAP, POPS)
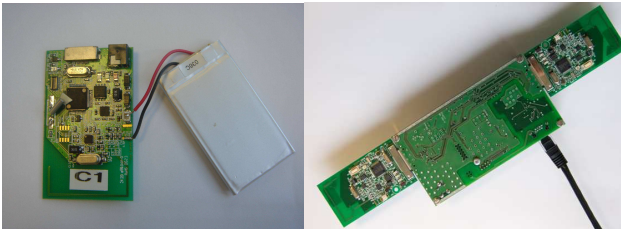- ▶ LSIIT, Strasbourg
- ▶ THALES, Paris

National WSN Testbed

SensLAB node architecture

▶ Developed by INRIA
▶ **Technical infos:**
  - TI MSP430 (16 bit);
  - Chipcon CC1100 & CC2420 (433-900-2400MHz/ ISM Band);
  - 1MB RAM Flash;
  - 16 pin extension connector (GPS / WiFi).

▶ Open MAC protocol & packet interface

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SensTOOLS ADT

SensTOOLS (2008-2010) main and most important goal was to foster the design, development, tuning, and experimentation of real large scale sensor network applications. The purpose of the SensTOOLS was to provide both software and hardware toolboxes in order to offer the developer appropriate tools and methods for designing, testing and managing his/her large scale wireless sensor network applications.

Consortium:

- ▶ ASAP, INRIA Rennes - Bretagne Atlantique Research Centre
- ▶ D-NET, INRIA Grenoble - Rhône-Alpes Research Centre
- ▶ POPS, INRIA Lille Research Centre
- ▶ SED, INRIA Grenoble - Rhône-Alpes Research Centre
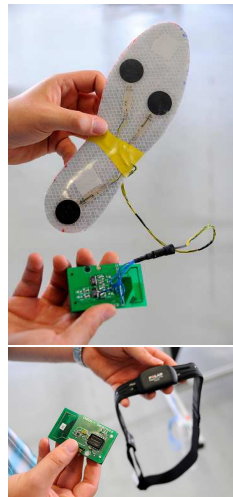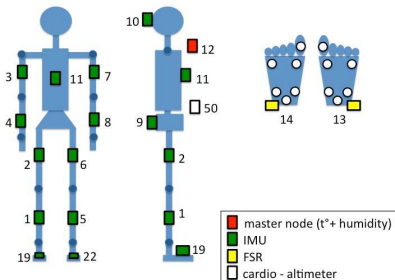- ▶ SED, INRIA Lille Research Centre

XTREMLOG application

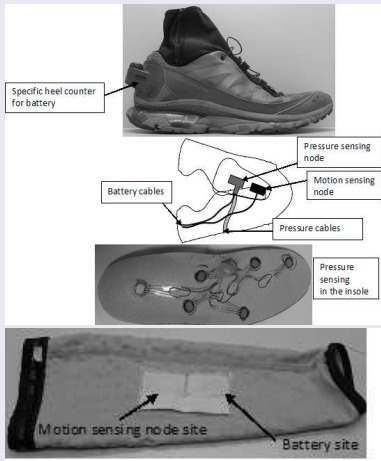Collaboration with DEMAR, INRIA Sophia Antipolis / LIRMM Montpellier

Daughter boards

- ▶ GPS, t°, humidity, altitude
- ▶ accelerometer, gyrometer, magnetometer
- ▶ force resistive sensors
- ▶ cardio frequencemeter

	master node (t°+ humidity)
	IMU
	FSR
	cardio - altimeter

Marathon des Sables

6 stage desert race

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SensAS ADT

SensAS ADT (2010-2013) aims at supporting applications implying sensor networks in different contexts.

Consortium:

- ▶ ALIEN, INRIA Saclay
- ▶ AMAZONES, INRIA - Rhône-Alpes
- ▶ DEMAR, INRIA - Sophia Antipolis
- ▶ D-NET, INRIA Grenoble - Rhône-Alpes
- ▶ MADYNES, INRIA - Rhône-Alpes
- ▶ NECS INRIA - Rhône-Alpes
- ▶ POPS, INRIA Lille Research Centre
- ▶ SED, INRIA Grenoble - Rhône-Alpes Research Centre

Wireless sensor network applications

SensAS organization

▶ **WP1: SensROB** Experimentation environment for robot fleet

ALIEN, DNET, NECS, POPS, SED

- Fleet of mobile robots
- Fleet of drones
- Localisation
- Communication strategy
- Network Control

▶ **WP2: SensBIO** Bio-logging applications

DEMAR, DNET, SED

- Sport Science
- Human Movement Science
- Rehabilitation

▶ **WP3: SensMGT** Sensor network supervision applications

AMAZONE, DNET, MADYNES

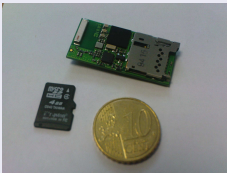- Supervision and configuration of wireless networks
- 6Lowpan / ROLL

▶ **WP4: SensBOX** Sensor and Actuator network software suite

AMAZONE, DNET, MADYNES, POPS, SED

SensBIO

Sport and Human movement science

- ▶ collaboration with SALOMON
- ▶ improving movement reconstruction
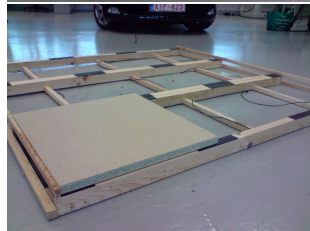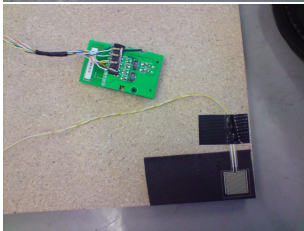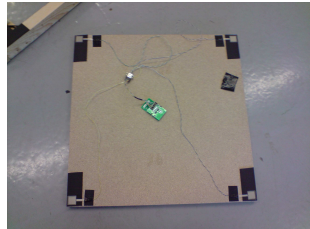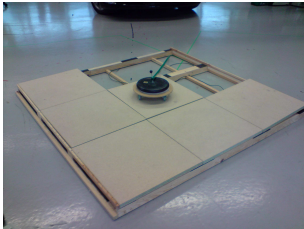- ▶ qualitative and quantitative data analysis

Functional Rehabilitation applications

- ▶ FES-assisted movements based on voluntary movement observation (Hemiplegic, SCI, ...)
- ▶ Monitoring activity and pattern recognition (PD patients, ...)

Exemple of hardware-software transfer

Collaboration with MAIA and SED, Nancy
Perceptive floor tiles

Conclusion

SensAS ADT has a dissemination role to assist INRIA teams in using network sensors.

▶ **SensLAB platform**

  ● http://www.senslab.info