Mobile applications and wireless sensor networks

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VTT in brief - VTT Electronics

6 Units:

VTT Electronics
VTT Information Technology
VTT Industrial Systems
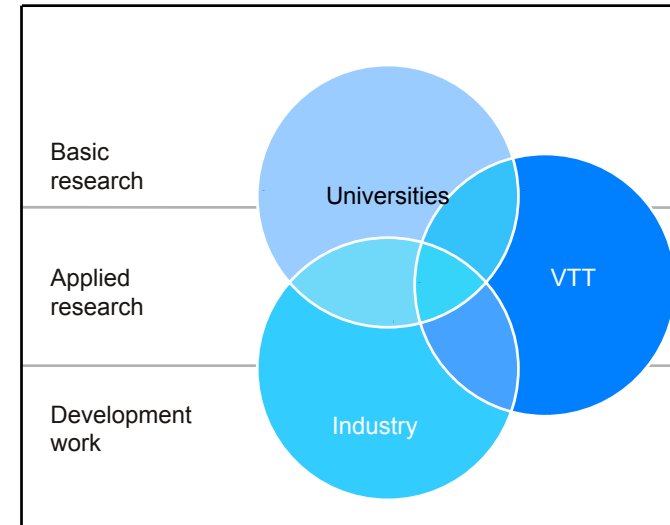VTT Processes
VTT Biotechnology
VTT Building and Transport

Staff: 2982
Turnover 219 M€

VTT Electronics

•Embedded SW
•Telecommunication systems
•Optoelectronics
•Advanced Interactive Systems

•Staff 300
•Turnover

Basic research — Universities

Applied research — VTT

Development work — Industry

Sensor-related R&D activities at VTT Electronics

Sensors

- to find out or to develop sensor components for specific applications
- modelling the physical phenomenon concerning especially the following measurements
- electromagnetic measurements , optical measurements, biometric measurements

Sensor electronics

- preamplifiers
- analog signal processing
- A/D-interface
- digital signal processing

Wireless communication:

- ultra-low power consumption of sensor nodes, autonomous power supply

Sensor Signal Analysis

- analysis of sensor signal in order to identify methods for feature extraction from sensor signals
- processing in restricted platforms

Sensor-based applications

- sensor-signal analysis and processing in order to add value for (mobile)applications

Mobile Applications, wireless sensors and data-processing

- Mobile application and mobile user
  - Most of the time people are equipped with a powerful networked computing platform (Mobile Phone)
  - Mobile Application & services is an interesting and growing business. There is a need for easy-to-use technologies in UI
    - Sensing technologies one possible solution

- Sensor-based activity sensing
  - Health care, fittness and wellbeing apps.
  - Reality Enhanced Gaming Experience

- Data Processing (Context recognition)
  - Processing: Sensor signal => features
  - Mapping: Features => meaningful activities (Context atoms)
  - Adaptation of applications: based on users activities
 - => Sharing users activity data (e.g. games, other apps)

SoapBox, a generic sensing and communication module developed by VTT Electronics (VTT, 2000 -

- An intelligent module incorporating a microcontroller, short-range wireless communication and a set of sensors
- Ultra low power operating modes
- Multiple powering options
- Embedded basic software (communication protocols, sensor drivers, API)
- Application software programmable by C
- Flexibly configurable and extensible
- Small size:

Measure

Control

Communicate

Sense
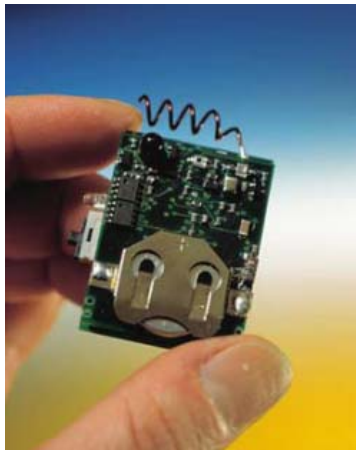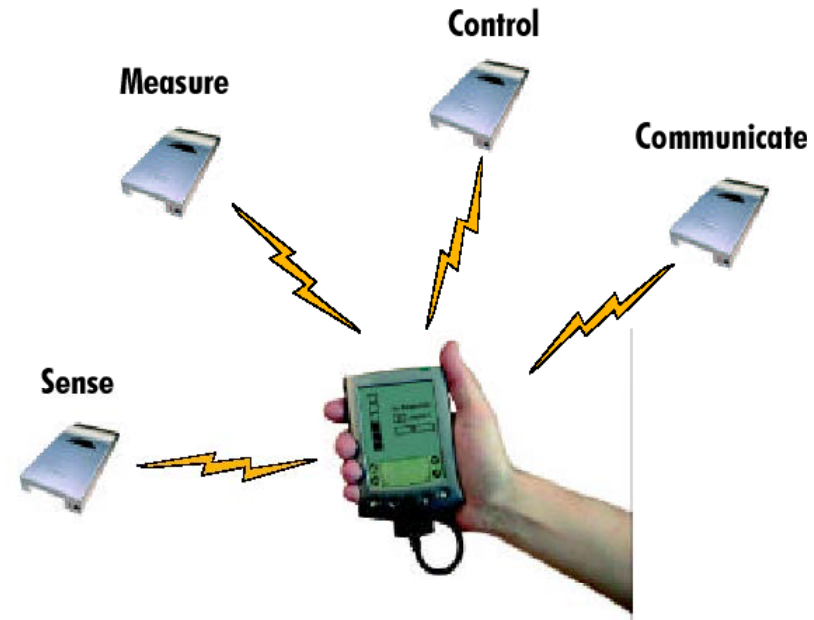
SoapBox is a platform for research projects as well as for rapid demonstrations and prototyping
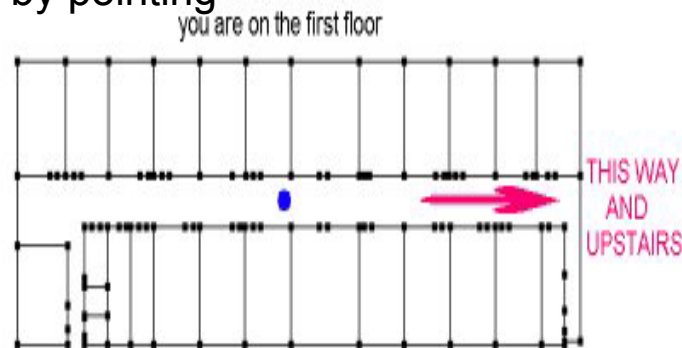
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SoapBox, hardware

- A single 8-bit flash microcontroller
- A 10 kbps RF proprietary data link operating at 868.3 MHz unlicensed band, range ~15 m
- RS-232 serial port
- Sensors (can be easily changed or removed):
  - acceleration (3 axis)
  - compass/magnetic
  - proximity
  - light intensity
  - temperature
- General purpose analog and digital I/O port
- Real time clock
- Supply voltage regulator with a large input voltage span (1.5 - 28 V)

- Constructed of commercial components on a PCB
- Remote and central nodes of network have identical HW

Public demonstrators using SoapBox-platform

- Short range wireless data links
- Gesture recognition user interface for TV, DVD player, PC etc.
- Two player maze game with novel user interface
- Indoor location estimation
- Sensor-enhanced UI for handheld device
- Compass for an autonomous robot
- Diverse sensors for outdoor data collections

- Wireless sleep disorder monitoring system
- Wearable sensing
- *Physical browsing* of objects by pointing
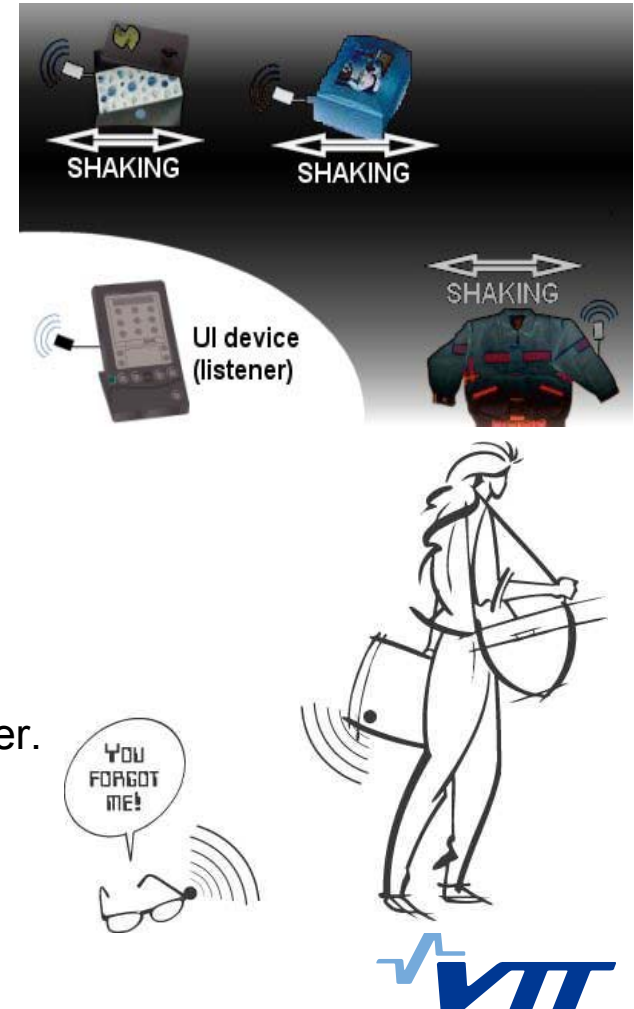- etc.

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Smart-its-project

Smart-its (2001 - 2003)

- "Interconnected embedded technology for digital augmentation of everyday objects + collective awareness"

- VTT in the project
  - context determination based on sensor-information (e.g. physical proximity, acceleration, etc.)
  - artefact-centric context management approach; contexts (permanent characteristics, static and dynamic) which are relevant for objects
  - light-weight software architecture for collective context recognition by objects

- Use Scenario: Smart-objects determines their context co-operatively. One of the objects sends the conclusion to the server.
  - Mobile phones / sensors + networking (GPRS/BT) as a wireless sensor network.
  - existing infrastructure, easy programming platform, big number of nodes
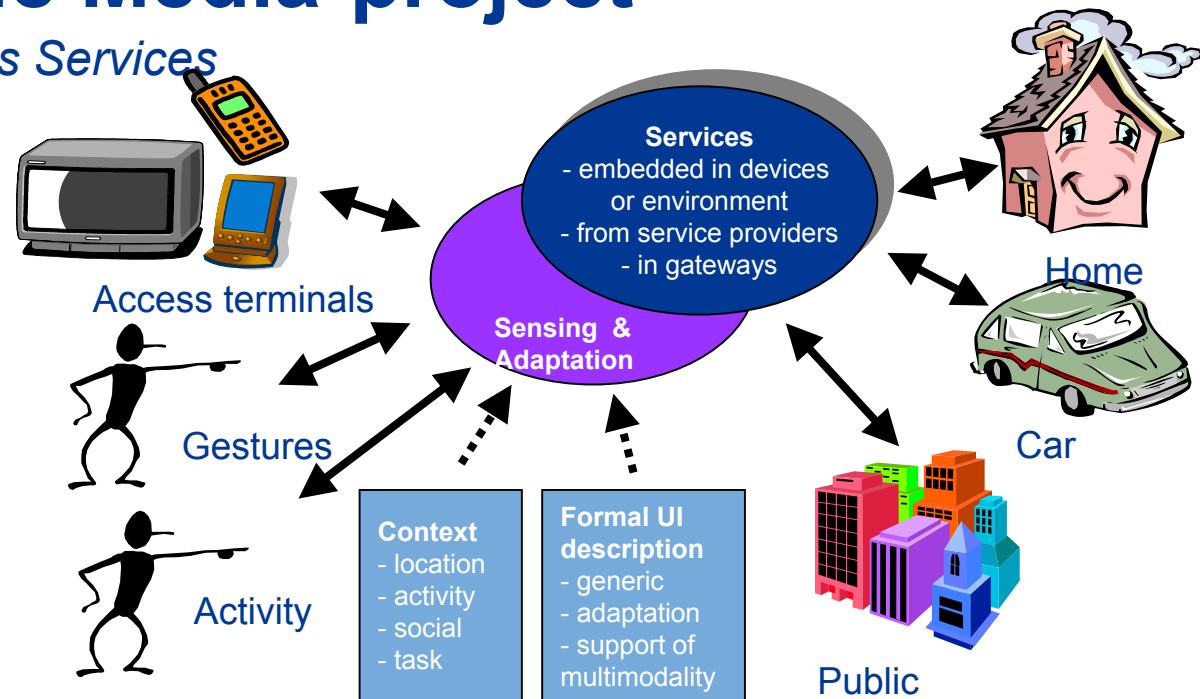

Partners: Univ.Lancaster, ETH, Univ.Karlsruhe, Interactive sinstitute, VTT

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Nomadic Media-project

Adaptive Interaction with Ubiquitous Services

Access terminals

Gestures

Activity

Services
- embedded in devices or environment
- from service providers
- in gateways

Sensing & Adaptation

Context
- location
- activity
- social
- task

Formal UI description
- generic
- adaptation
- support of multimodality

Home

Car

Public

The focus of VTT in Nomadic Media :

- Context capture using e.g. **wireless body area sensing network**

- Context description format and ontology

- XML-based description language for user interfaces

  - Special emphasis on adaptability (context, user, terminal, modality),

  - Support for alternative modalities like speech, gestures & pointing

- An open architecture for:

  - context information sharing,

  - adaptive service development

Partners: Philips, Euskaltel, Atos-Origin, Vodafone, CiaoLab, Cefriel, Nokia, Cybelius, VTT, Sysopen, Oulu univ.

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Future work at VTT

Applications

- Domains
    - Everyday use of mobile technology
    - Fitness
    - Support for elderly people
    - Digital augmentation of real world objects
- Environmental sensing
    - Single sensors =>network of sensors
        - reliability, flexibility
    - Use of diverse inexpensive sensors
    - Light-weight data processing in nodes

Technologies

- Sensors
    - Optical measurements
    - Biometric measurements
    - Electromagnetic measurements
   - Sensor electronics, sensor signal processing, noise analysis
    =>Further development of SoapBox-platform
- Data processing
    - Context fusion (which contexts are relevant for application, high-level context detection)
    - Application adaptation to contexts (taking action on behalf of the user automatically is tricky)

Features

- low sampling rate : 12 Hz
- simplicity of step detection : peak count of magnetic sensor data
- independent analysis of each step
- all data processing in time domain
- simplicity of step classification : small look-up tables
- small need in computing resources
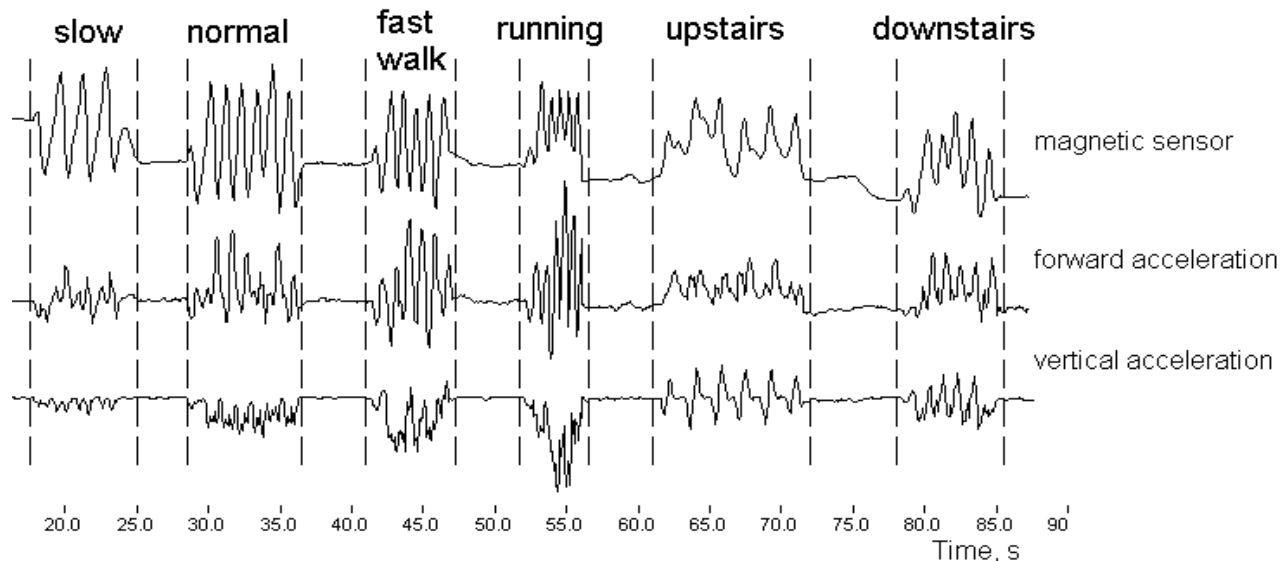
Context from audio analysis
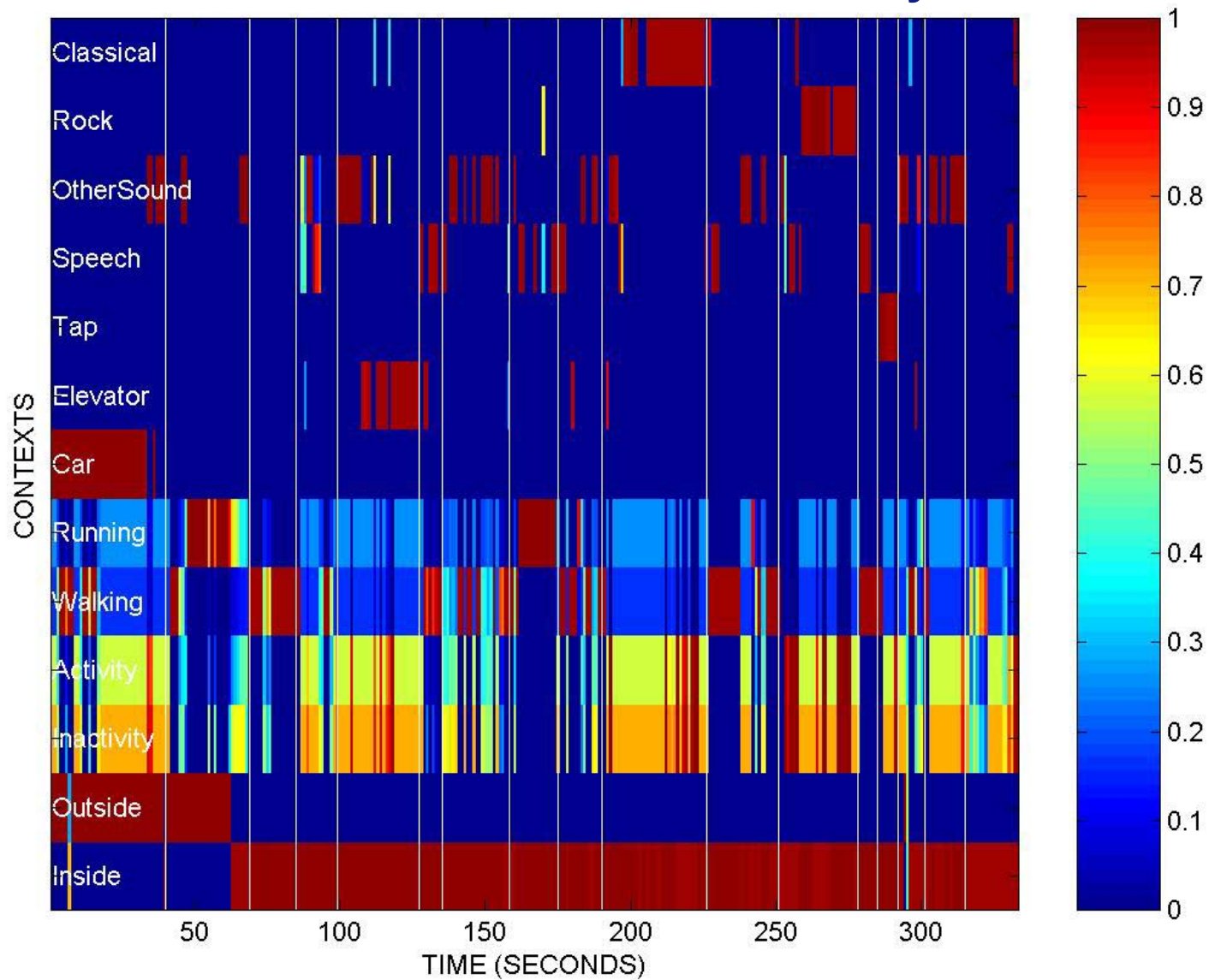
Health monitoring

Sensors and devices do not solve the problem: need for processing and infrastructure to draw any advantages!