ARTIFICIAL INTELLIGENT SYSTEMS

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AMBIENT INTELLIGENT SYSTEMS

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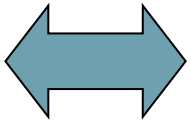
Lecture Topics

- Introduction and terminology
- Ambient Intelligence (AmI)
- The vision of AmI
- The components of AmI
- Examples of AmI scenarios
- Criticism and concerns

Terminology

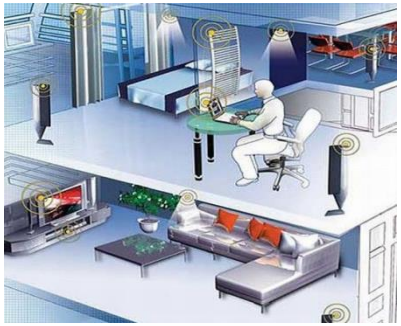
- The shift of the research paradigm:
  - from the techno-centric ***artificial intelligence***,
  - to the human-centric ***ambient intelligence***.



Terminology and related terms

- The term ***intelligent house*** eventually diverged into several different terms.

- New terms are being coined, such as:
  - smart houses / homes / environments
  - integrated houses / homes / environments
  - live / interactive houses homes / environments.



The emergence of a ubiquitous computer

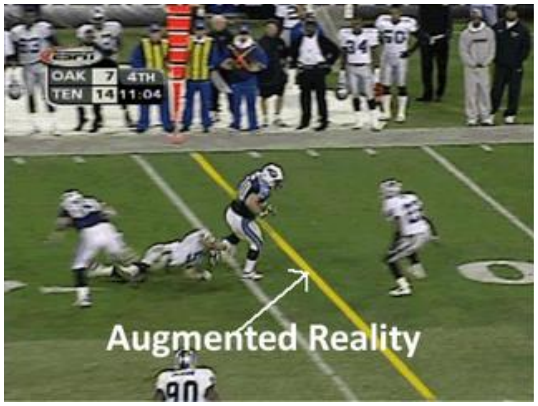
- "Ubiquitous intelligence/computing"
- "Pervasive intelligence/computing"
- "Versatile intelligence/computing"
- "Everyware"
- …

UBIQUITOUS COMPUTER

- The interaction between humans and computers is slowly surpassing the prevalent desktop work.

Augmented reality

- A combination of real and artificially formed data.



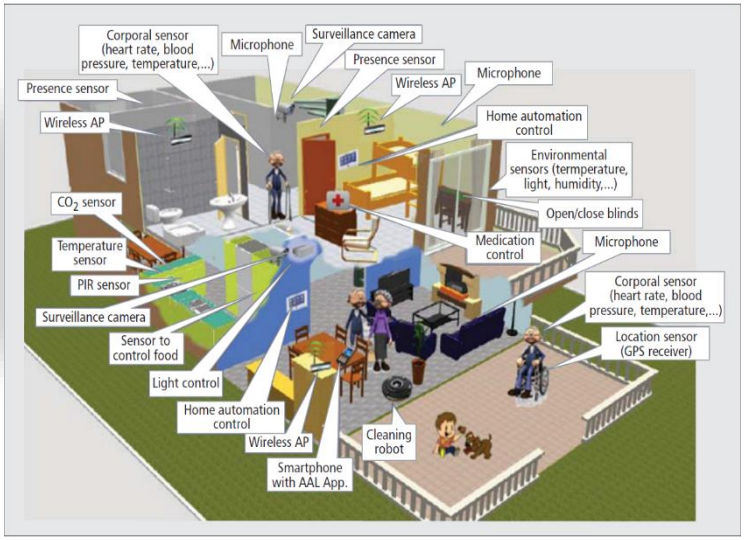
Ambient intelligence

- Ambient Intelligence (AmI) refers to electronic environments that are ***sensitive*** and ***responsive*** to the presence of people.
- Ambient Intelligence is a paradigm of a
  - ***ubiquitous***,
  - ***unobtrusive***,
  - ***transparent*** and
  - ***intelligent***

  support systems for users.

Ambient intelligence

- In AmI vision, users are surrounded by intelligent user interfaces supported by networked information-communication technologies (ICT), embedded in everyday objects.
- The ICT components are hidden in the background, where people are put forward in the control of the improved environment.



The history of Ambient Intelligence

- In 1998, Philips commissioned a series of internal workshops to investigate different scenarios that would transform the consumer electronic industry into a world in 2024 where user-friendly devices support ubiquitous information, communication and entertainment.

- D. A. Norman, "The invisible computer", 1999.

- "The AmI challenge", the call for projects of the European Commission, 2001.

- The report of the Information Society and Technology Advisory Group IS-TAG, "Scenarios for Ambient Intelligence in 2010"

The vision of AmI

- AmI is technologically enhanced environment that:
  - is aware of the presence of people,
  - adapts to their needs,
  - response intelligently to their speech and gestures,
  - is capable of engaging in an intelligent dialogue,
  - is unobtrusive and supports relaxed interaction,
  - includes interoperability between different environments (homes, workplaces, vehicles, public spaces ...)

The use-value of AmI

- Improvement of citizens' safety
- New opportunities for work, learning and entertainment
- New forms of health and social care
- Tackling environmental problems
- Improvement of the public service
- Modernization of the social model
- Support for democratic political process

Support for the home environment

- The home AmI environment can meet and enrich the individual with more flexible participation in the work, learning, fun and socializing with other people.

Health and Social Care

- An AmI environment allows individuals to manage their health more responsible and actively.
- AmI makes monitoring of the health status of those affected easier and more effective .
- AmI provides effective support for the protection of vulnerable groups such as the elderly and children.

Governance and Public Service

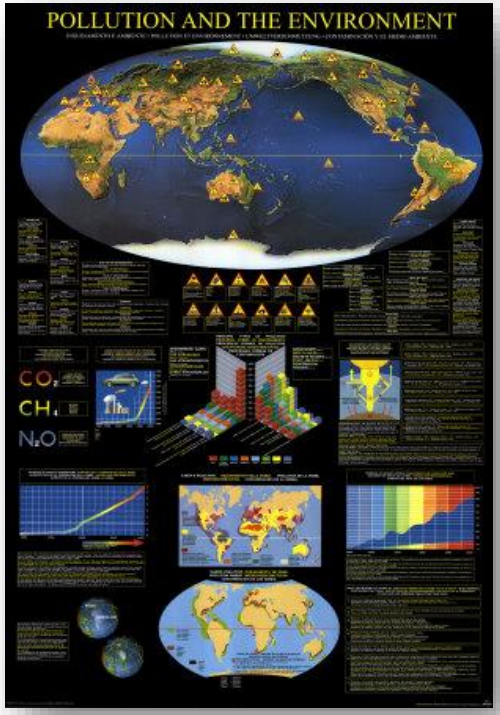
- AmI allows the creation of economic and social public service that is truly user-friendly for all users anywhere, anytime.

Security of Citizens

- AmI could contribute to a more reliable risk assessments, detection and reduction by remote sensing and control.

Environment Protection

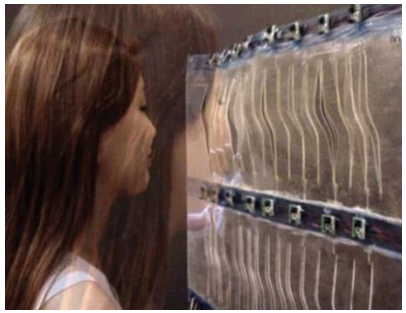
- AmI offers new opportunities in protecting the environment and the shift from the nowadays usual environmental monitoring to the knowledge management for advanced decision support.

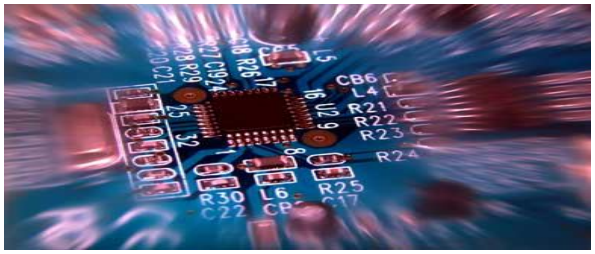


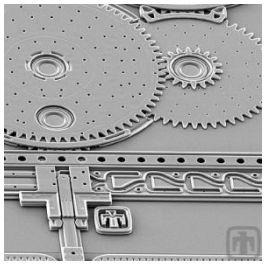
Mobility and transport

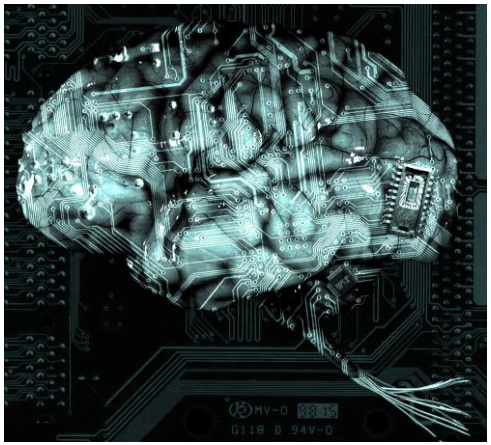
- AmI environment can significantly improve traffic safety and overall efficiency of the transport system.

AmI components

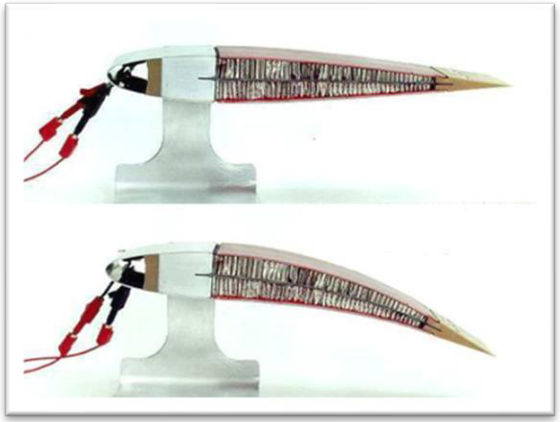


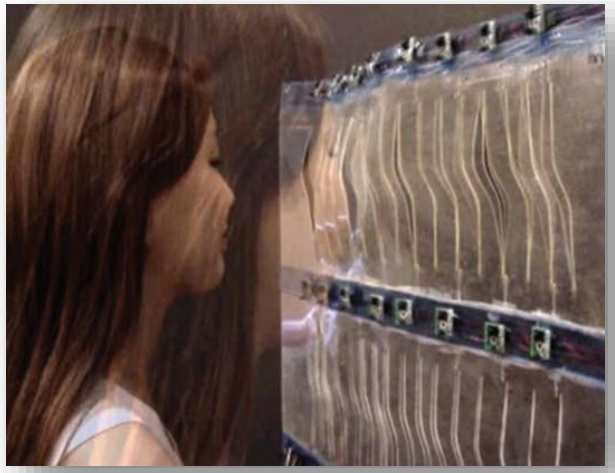






Components for the ambient (1/4)

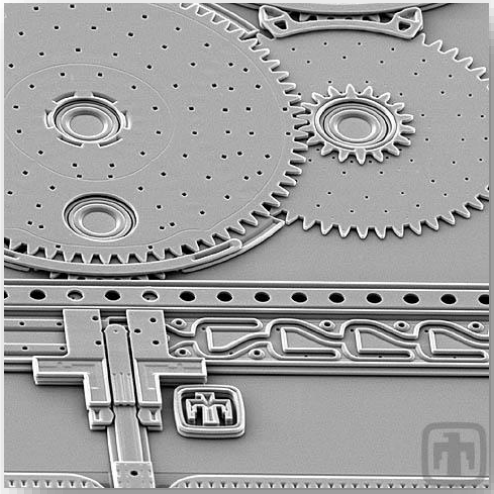




- Smart materials
  - Emit controlled light
  - Are sensitive to touch
  - Have memory and process data
  - Can be embedded in goods, etc

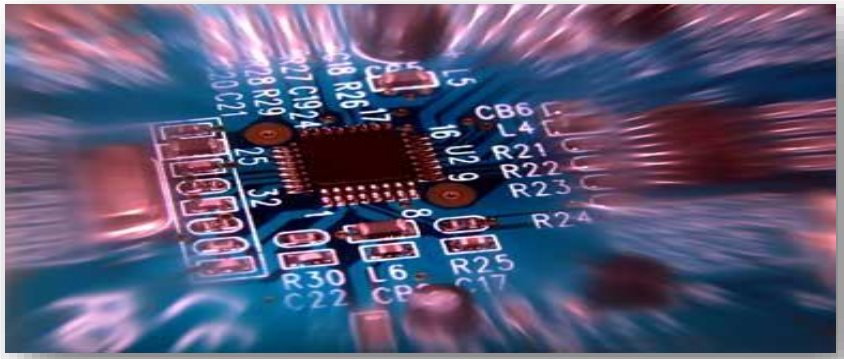
Components for the ambient (2/4)

- Micro-electromechanical systems and sensors
  - Low-energy activators
  - Sensors for touch, sound, light, smell, ...
  - Integrators of smart materials



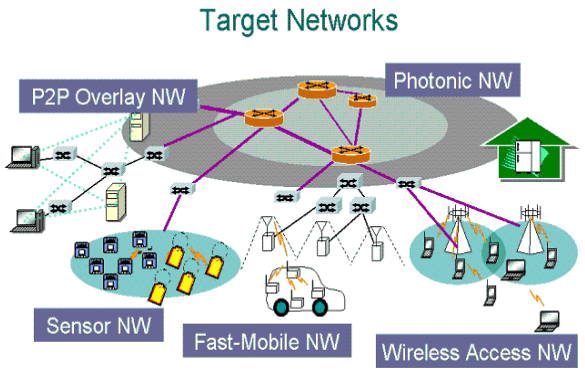
Components for the ambient (3/4)

- Embedded systems
  - Flexible systems that run in real-time
  - Have the possibility of remote diagnostics and maintained
  - Emphasis on security and reliability



Components for the ambient (4/4)

- Ubiquitous communications
  - Pico radio networks for active and passive tagging
  - Internet accessibility for any object
  - Ubiquitous broadband access to data
  - Ubiquitous hands-free voice control
  - Graphical interfaces on any surface
  - 5G digital cellular networks
    - Enhanced Mobile Broadband (eMBB),
    - Ultra Reliable Low Latency Communications (URLLC), and
    - Massive Machine Type Communications



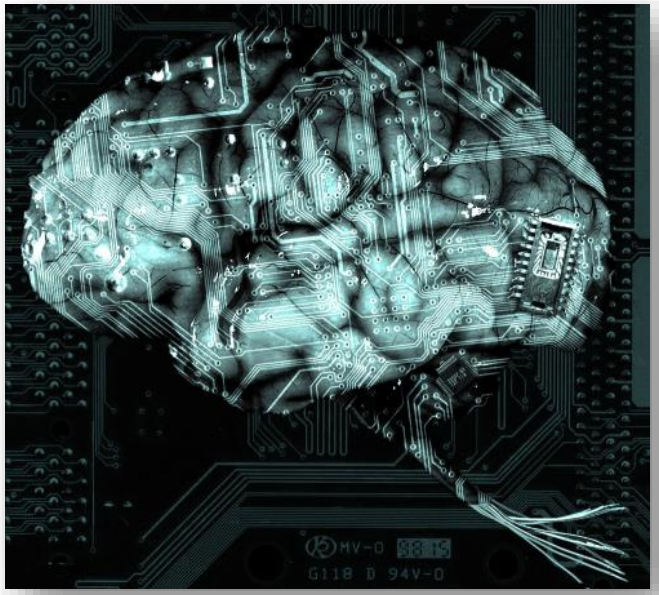
Components for intelligence (1/5)

- Content management
  - Languages for the presentation of content
  - Tools for accessing the semantic web
  - Tools for analyzing the content
  - Automatic enrichment of content with meta data

Components for intelligence (2/5)

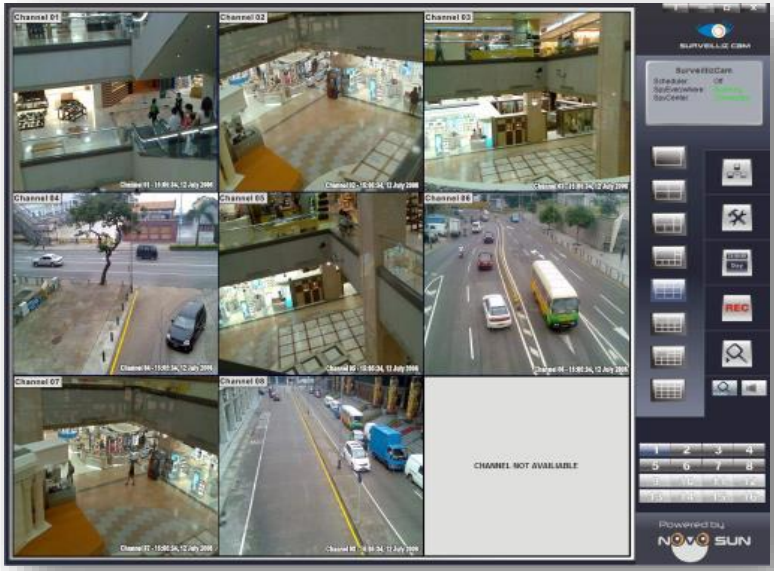
- Multi-modal natural interaction that involves
  - facial expressions,
  - gestures,
  - speech,
  - computer vision.

Components for intelligence (3/5)



- Computer intelligence
  - Interactive content search
  - Systems for dialogue
  - Behavioural modelling
  - Problem solving and planning

Components for intelligence (4/5)



- Context awareness
  - Navigation systems
  - Systems for localization and tracking
  - Automatic search of support
  - Smart surveillance

Components for intelligence (5/5)

- Computer emotions
  - Modelling emotional states
  - Responding to the emotional states of users
  - The expression of emotional states

Examples of AmI scenarios

RESEARCH INITIATIVES

- *Ambient Intelligence Group, CITEC, Bielefeld University.*
- *Ambient Intelligence Laboratory, National University of Singapore.*
- *Ambient Intelligence Research Group, Ulster University, UK.*
- *Alcatel-Lucent Research&Innovation. Ambient Services Group.*
- *Ajou University, CUSLAB – Well-Being Life Care Research*
- *Autonomous University of Barcelona – CAIAC.*
- *Autonomous University of Madrid – AmiLab.*
- *Carnegie Mellon University. CyLab – Ambient Intelligence Lab.*
- *DAI – Domotics and Ambient Intelligence, University of Alicante (Spain).*
- *University of Deusto, MoreLab – Mobility Research Lab.*
- *Fraunhofer Institute. Ambient Assisted Living.*
- *LIMSI-CNRS, Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur*
- *MAmI – Modeling Ambient Intelligence – UCLM, Spain.*
- *MIMOSA project – Microsystem Platform for Mobile Services & Application*
- *MINAmI project – MIcro-Nano integrated platform for transverse Ambient Intelligence applications*
- *MERL. Ambient Intelligence for Better Buildings.*
- *MIT Media Lab. Ambient Intelligence group.*
- *e-Lite Research Group, Politecnico di Torino.*
- *University of Palermo. Department of Computer Engineering. Distributed Artificial Intelligence group.*
- *NTT Research. Ambient Intelligence Research Group*
- *Philips Research. Ambient Intelligence Research in ExperienceLab.*
- *…*

Criticism

- The social, political and cultural concerns exist due to the potential loss of privacy and the concentration of excessive power in individual organizations.

- The possibility of the development of excessively individualized and fragmented society in which individuals in their hyperreal world will no longer distinguish between the real and the virtual.

Questions

- What a shift of paradigm do we make with the transition from Artificial Intelligence to Ambient Intelligence?
- What do we mean by "ubiquitous/disappearing computer"?
- What is the vision of AmI?
- What is the use-value of AmI?
- What are the main types of the AmI components?
- What are the concerns in the development of AmI?

PUBLICATIONS

- SAME Series - Semantic Ambient Media Series Workshop
- JAIHC - Journal of Ambient Intelligence and Humanized Computing
- UCAmI - Symposium of Ubiquitous Computing and Ambient Intelligence
- IJACI - The International Journal of Ambient Computing and Intelligence
- JAISE - The International Journal of Ambient Intelligence and Smart Environments
- AISE - Book Series on Ambient Intelligence and Smart Environments
- I-o-T.org - Internet of Things : mainly based on Ambient intelligence
- IE'19 - Intelligent Environments Conference
- …