



MONTIE Workshop
November 24th-25th 2005,
Technological Institute, Taastrup, DK

Multisensors and Other New Technology
for Improved Indoor Environment in Buildings

What do we have and what do we need ? – to Control the Future Indoor Climate

Jens Møller Jensen, Danfoss A/S

Jens Møller Jensen



norden

Nordic Innovation Centre



Multisensors and Other New Technology for Improved Indoor Environment in Buildings

Contents

MONTIE Workshop



The Focus in Indoor Climate

State of the art ?

Segmentation of the field

Future needs ?

The Focus in Indoor Climate

MONTIE Workshop



- There is a **continuously increasing focus** on quality of indoor climate
- The background and objectives vary
 - **Comfort, health, social economy, productivity, trend, business...**
 - **Application, technologies...**
 - **HVAC versus IAQ/IEQ...**
- The **specific technical focus** varies depending on
 - **Opportunities, interest, environment, local policy...**
- The generally common goal is *improvement* – **but the needs and requirements are unclear**

The Focus in Indoor Climate

MONTIE Workshop



- The **range of issues** is wide
 - Modeling, methods, parameter, indicators
 - Materials, sensors, actuators, demonstrators
 - Systems, applications
 - Efficient, energy use, human behaviour, etc. etc.

and there is

- A number of **overall issues to clarify** in order to boost the *general development and spreading* of improved systems
 - What are the **most important factors** in future indoor climate?
 - How do we **obtain simplicity** of **integrated HVAC/IAQ** systems ?
 - How do we **make it affordable**?

State of the Art? MONTIE Workshop



- State of the art appears to be **two-fold**
 - State of the Art at **academic levels**
 - Increasing number of hi-tech **sensors**, proposed **methodologies**, control **schemes**
 - Still **uncertainties** as to **what is really needed** and what is hype...
 - **Commercial aspects** often neglected
 - State of the Art in **practice**
 - Degree of **implementation is low**
 - **Adoption** is still **slow**
 - Academic **research results often not suitable** for implementation in concurrent applications
 - Commercial aspects implies **very diversified requirements**

Technology drivers

MONTIE Workshop



- **Avionics and aerospace**

- Comfort and safety in cockpit and passenger cabins

- **Automotive**

- Comfort (and safety) in passenger cabins

- **High end building facilities**

- Comfort in concert halls and conference rooms

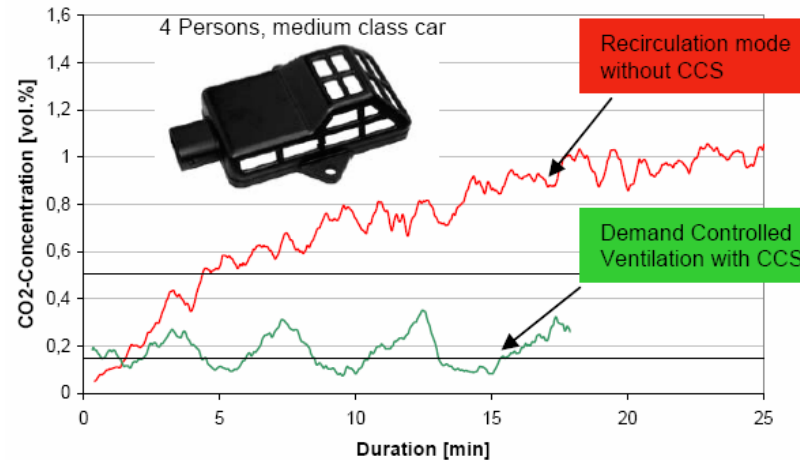
- **Outdoor climate and environmental surveillance**

- Understanding climatic change and dynamics
- Pollution control and warning systems
- Optimisation of agricultural production

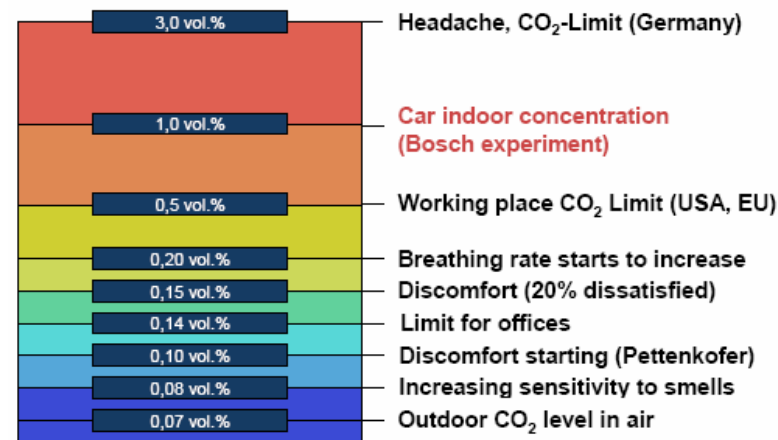
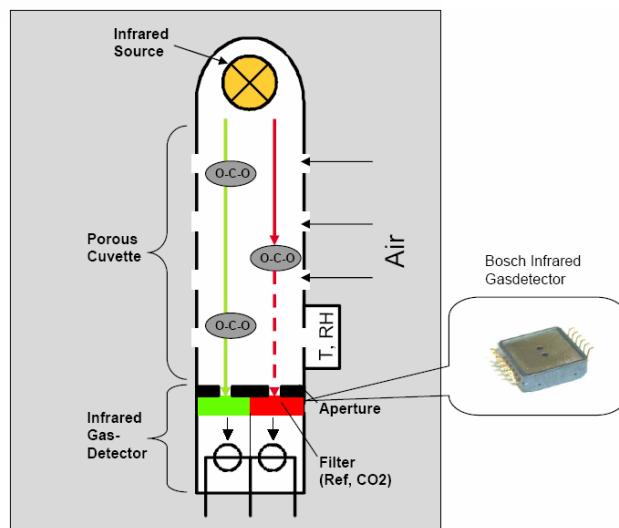
- **Military**

- Early warning systems
- Intelligence

Example 1 - Automotive MONTIE Workshop



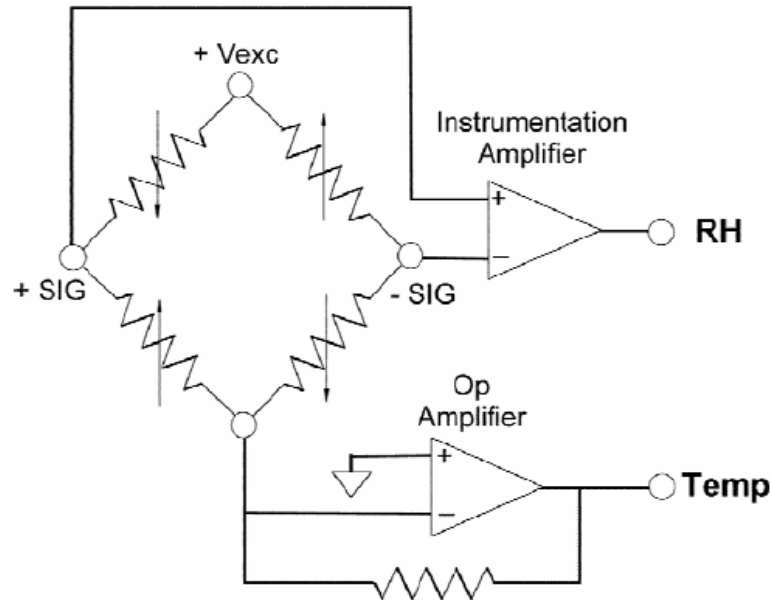
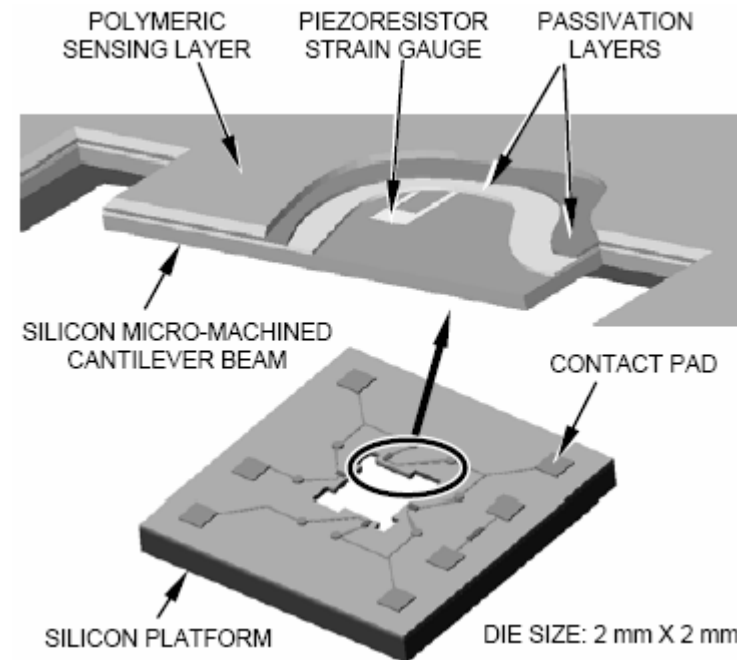
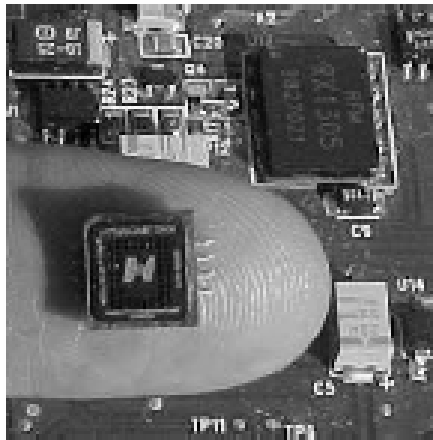
Source: Bosch Medical Service



Jens Møller Jensen

Example 2 - MEMS multisensor

MONTIE Workshop



Applications

- Environmental monitoring and control
- Avionics and aerospace
- Dehumidification, industrial drying
- HVAC
- Precision instrumentation

Jens Møller Jensen



Example 3 - Low power wireless

MONTIE Workshop

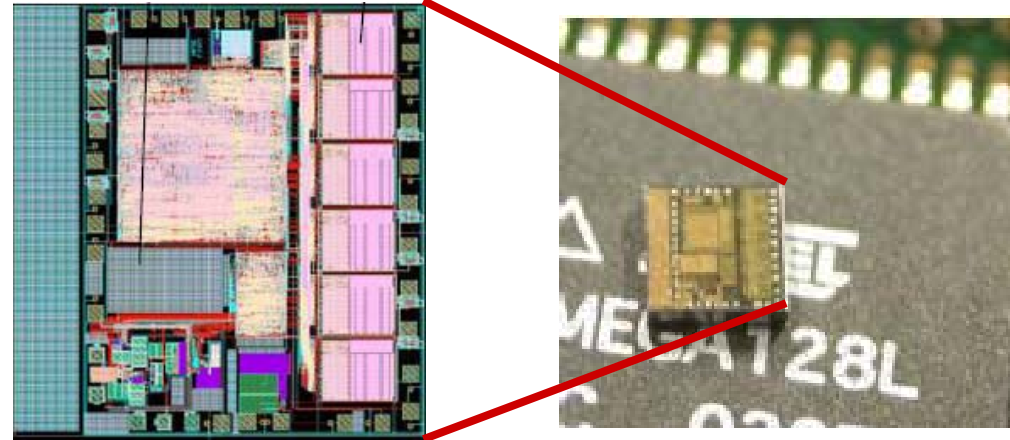


Low Cost translates to minimal “Real-Estate” on μ C/Radio chip

3K RAM = 1.50 mm²
CPU Core = 1 mm²
RF COMM stack = 0.50 mm²
SmartDustRADIO = 0.25 mm²
SmartDustADC = 0.02 mm²

Adopted from UC-Berkeley: BSAC

Berkeley Sensor
& Actuator
Center (BSAC)



Low Power relates to: “Total Energy = Sleep + Warm-Up + Active”

Low power sleep mode	: 1 μ W (400+ years on AA battery)
Low power duty mode	: 150 μ W per MHz
Low power radio	: 1 mW @ 100Kbps ; 90dBm receive sensitivity, (10 nJ/bit)
Low duty cycle	: Low sample rate (minutes), fast sampling (10 ms)
Low power sensor	: < 1 μ J/sample (e.g. 100 μ W for 10 ms)
Fast warm-up from sleep	: Comparable or less than sampling time.

Segmentation of the Field

MONTIE Workshop



- In practice, the field of applications has (at least) two segments
 - **Building Management Systems**
 - **Well-known application area** yet there are still major unsolved problems
 - The overall driver is **economy**
 - Investment and pay-back - How can pay-back be quantified ?
 - **Residential systems**
 - Early-stage application area – lack of mature systems and knowledge
 - The overall driver is ... **economy, comfort, health, prestige...**
 - Investment and payback...or?
 - Divided into **new** and **retro-fit** applications

Future needs

MONTIE Workshop



• General

- **Integration**
- Well established *and effective* system **control strategies**
- Identification of general **suitable markers**
- General component- and system (self-organised) **communication**
- More **dedicated components** (Low cost, Low power)

• Building Management Systems

- Better system integration
- Affordable sensors integrated into HVAC/IAQ system components
- Long-life (10 yr+), low-power, communicating sensors – preferably wireless
- Firm identification of general markers for good indoor climate

• Residential systems

- True integrated systems
- Easy-to-install self-configuring HVAC/IAQ system components
- Affordable long-life (10 yr+), low-power, wireless sensors
- Firm identification of *very* general markers for good indoor climate
- Documentation of system effects and pay-back

Further Contact

MONTIE Workshop



Danfoss A/S

Web: www.danfoss.com

Jens Møller Jensen (B.Sc, MMT, Exec.MBA)
Manager Technical Business Development
Heating Division

E-mail: jensen@danfoss.com

Phone: +45 7383 0000

Jens Møller Jensen

Copyright © Danfoss A/S. Any publication, distribution, reproduction or use of this material in part or in full without the written consent of Danfoss A/S and the authors is prohibited

