DEMAND-CONTROLLED ENERGY SYSTEMS IN COMMERCIAL AND INSTITUTIONAL BUILDINGS

A review of methods and potentials

Shoaib Azizi, Gireesh Nair, Thomas Olofsson

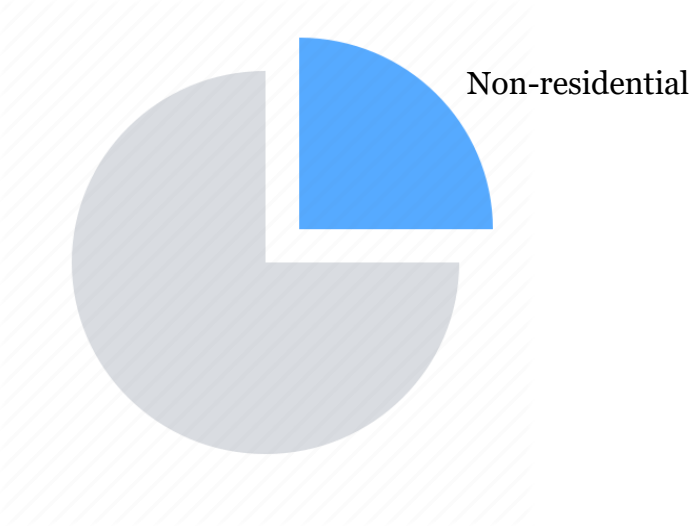


UMEÅ UNIVERSITY

ENERGY USE IN NON-RESIDENTIAL BULDINGS

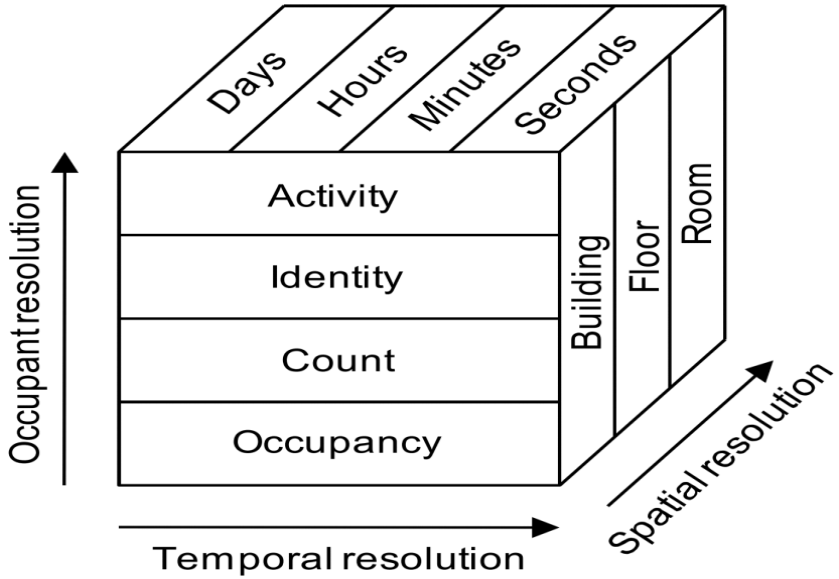






QUALITY INDICATORS OF OCCUPANCY DETECTION

- Resolution



(Melfi et al. 2011)

- Accuracy

TECHNOLOGIES AND METHODS

- PIR sensors
- Ultrasonic sensors
- CO_2 sensors
- Vision based occupancy detectors
- Chair sensors
- Ambient sensors







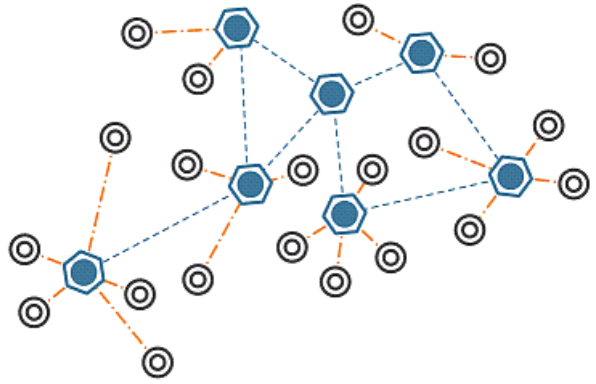




TECHNOLOGIES AND METHODS; EMERGING APPROACHES

- **Implicit occupancy sensing**
  - Tier 1: Data is readily available
  - Tier 2: Additional software is required
  - Tier 3: Additional software and hardware is required

- **Network of sensors**



ENERGY EFFICIENCY POTENTIAL

Author(s)	Sensing technology	Detection accuracy	HVAC energy savings	Climate	Energy saving calculation method
Erickson et al. (2011)	Network of low resolution cameras	80%	42%	Average of 3 climates	Computer simulation-EnergyPlus
Dong and Lam (2011)	Network of environment sensors	83%	18.5%	Humid continental climate-Pittsburgh	Computer simulation-EnergyPlus
Erickson and Cerpa (2010)	Sensor network of cameras	80%	20%	Local steppe climate-Fresno	Computer simulation-EnergyPlus
Newsham et al. (2017)	Office IT equipment	>90%	16.6-64%	semi-continental climate-Ottawa	proof-of-concept demonstration
Agarwal et al. (2010)	PIR sensors	Not specified	10-15%	Tropical and Subtropical Steppe Climate-San Diego	Computer simulation-EnergyPlus
Goyal et al. (2013)	PIR and ultrasound	Not specified	50%	Humid Subtropical Climate-Gainesville	Field study
Peng et al. (2017)	Motion and indoor climate sensors	93%	20.3%	Tropical Rainforest Climate- Singapore	Field study
Dong et al. (2018)	PIR sensors	70%	20%	Not specified	Field study

VARIATION IN ENERGY SAVING POTENTIAL

- Intensity of occupation (Guo et al. 2010)
- Climate condition (Erickson et al. 2011)
- Baseline control strategy (Shen et al. 2017)

OTHER APPLICATIONS

- Remodelling, converting and reusing spaces
- Security
- Demand response
- Energy information used for behavioural change



CONCLUSION AND AREAS FOR FURTHER RESEARCH

- Multi sensor data fusion
- Privacy concerns
- Development of applications



THANK YOU!



UMEÅ UNIVERSITY