WIRELESS SENSOR AND ACTUATOR NETWORK FOR PERSONAL THERMAL COMFORT MANAGEMENT

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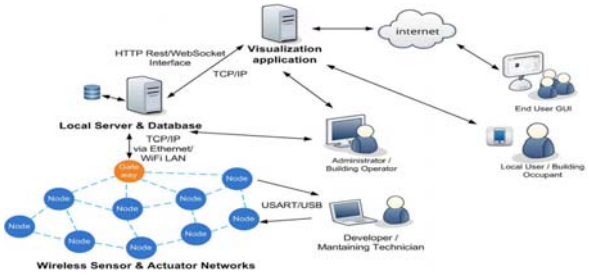
Motivation and Background

- 1°C increase in the air-con setpoint results in 3% reduction in energy consumption
- Individual cooling needs are provided by elevated air movement through personal fans

User comfort and well-being in buildings depend on

- *Environmental factors*
  temperature, relative humidity, air speed, air quality, illumination etc.
- *Psychological and behavioral factors*

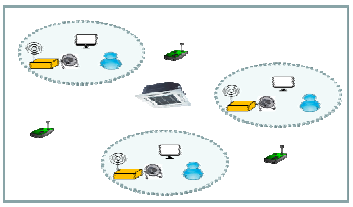
Need frameworks that facilitate the paradigm shift to dynamic, non-uniform, people-centric thermal landscapes in the built environment



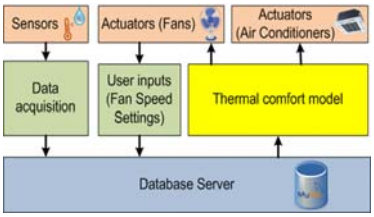
General WSAN Architecture for Smart Buildings

- Each WSAN may contain hundreds to thousands of sensor and actuator nodes and in a modern building, there might be a few WSANs deployed and cooperating with each other
- Data exchanged amongst the nodes including sensing values, control commands, device and network status can be stored in common data centres

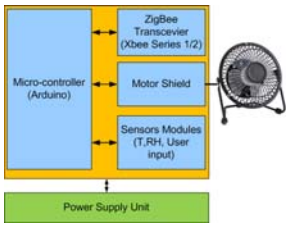
Wireless Sensor and Actuation Network (WSAN) Framework



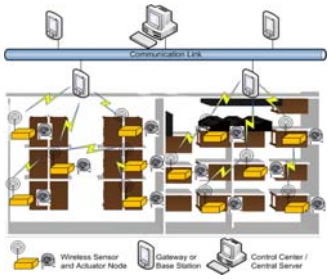
WSAN deployment scenario



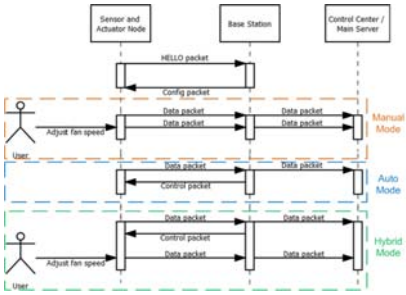
General WSAN framework for personalized thermal comfort



Architecture of Wireless Sensor and Actuator Node



WSAN deployment in a building



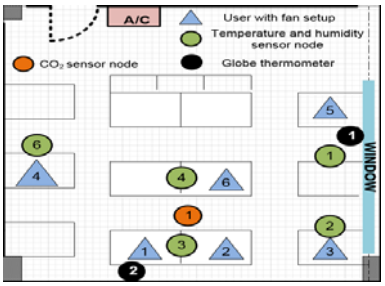
WSAN operation in three modes

Manual Mode: Manual control of the local comfort device by the users

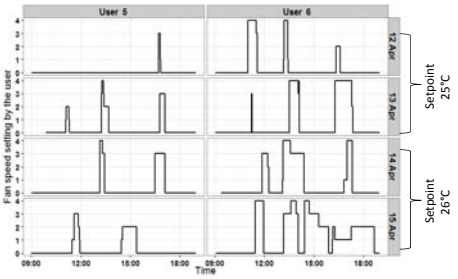
Auto Mode: Automated control of the local comfort device not allowing user input

Hybrid Mode: Automated control of the local comfort device with the facility of user input

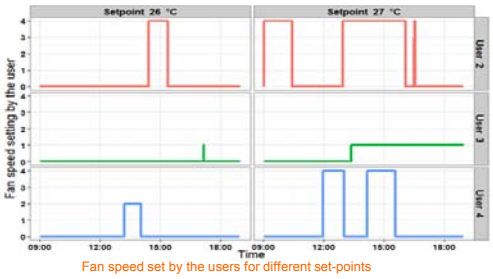
Manual Mode Operation : Experimental Results



WSAN deployment in an operational office-space room



Fan speed set by two users for different days during the working hours



Fan speed set by the users for different set-points

Setpoint	Duration of the fan usage (in mins)			
	User 2	User 4	User 5	User 6
25°C	106	59	63	186
26°C	145	124	136	425
27°C	274	184	236	431

- Prolonged use of fans at higher temperature
- Occupants use fans to restore comfort after breaks

- ✓ The framework can play a role in establishing models that predict human comfort and adapt to user preference in **transient, non-uniform thermal environments**
- ✓ Additional experiments are required to **substantiate the thermal comfort improvement and energy benefits**

[1] Sindhu S. Shetty, Hoang Duc Chinh, Manish Gupta and S. K. Panda, "Personal Thermal Comfort Management in existing Office Buildings using Energy-efficient Fans", 42nd Annual Conference of IEEE Industrial Electronics Society – IEEE IECON 2016.
[2] Hoang Duc Chinh, Sindhu S. Shetty, Manish Gupta and S. K. Panda, "A Wireless Sensor and Actuator Network (WSAN) framework for Personalized Thermal Comfort in Office Buildings", 4th IEEE International Conference on Sustainable Energy Technologies – IEEE ICSET 2016.

"This research project is funded by the National Research Foundation Singapore under its Campus for Research Excellence and Technological Enterprise (CREATE) programme."