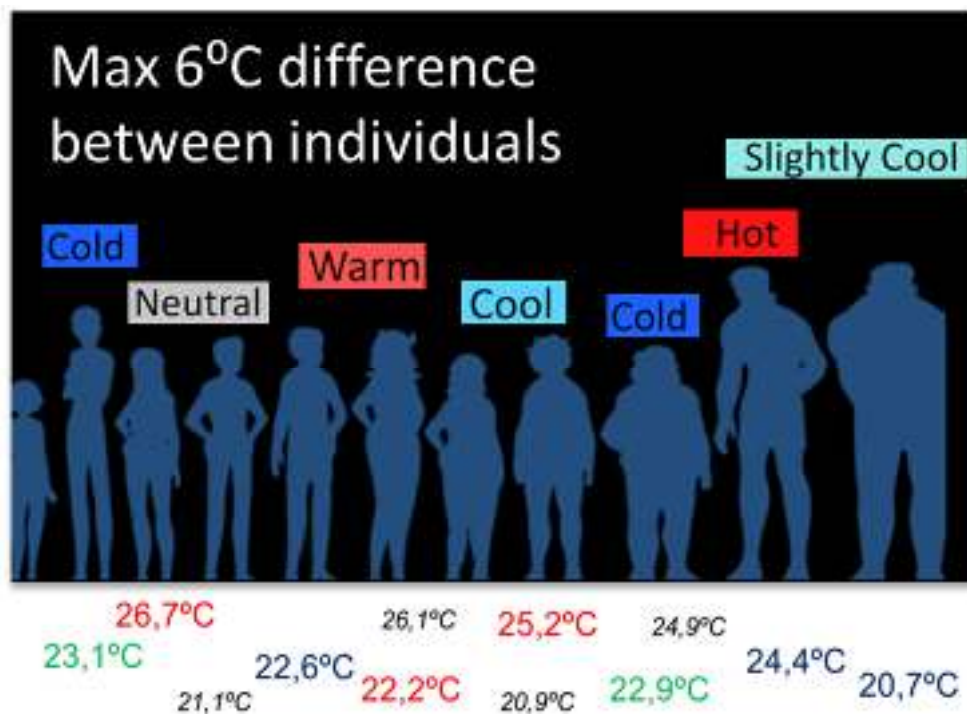


Human Thermal Models and building interactions

**ECTP Conference, 2-3 December 2021
Kalevi Piira (VTT)**

20/12/2021 VTT – beyond the obvious

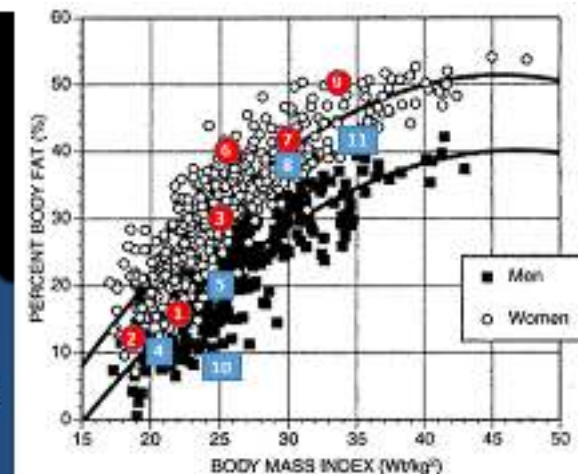
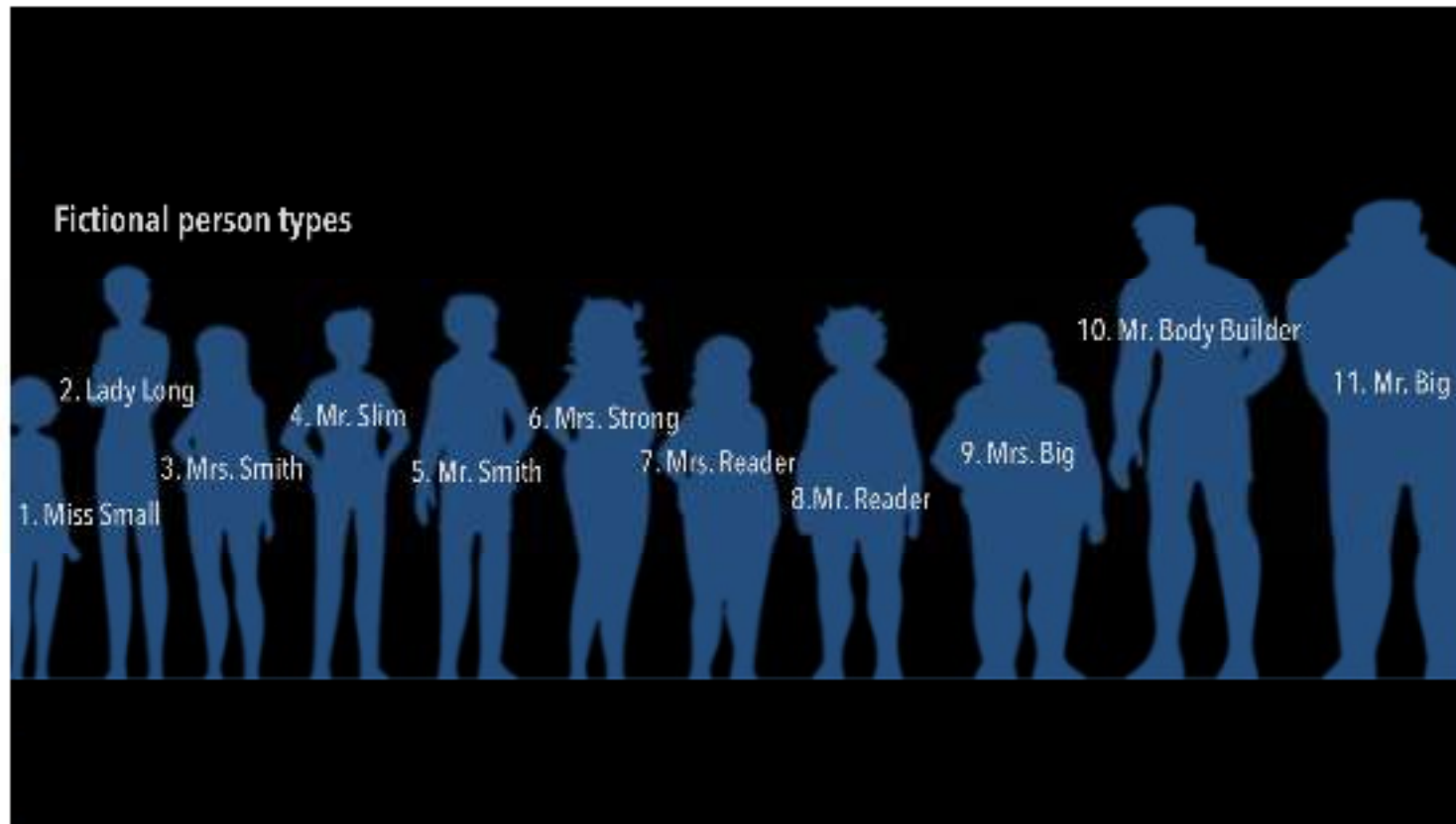
Human Thermal Model (HTM) - Background



- Individuals may have even 6 degrees indoor air temperature difference on what is preferred comfortable.
- In same indoor conditions some feel cool and some feel warm.
- Thermal comfort models
 - Fanger PMV is an average model
 - VTT's HTM is an individual model
- Human Thermal Model provide continuously optimised individual indoor thermal conditions.
- Approach is based on science.

<https://www.vttresearch.com/sites/default/files/pdf/science/2012/S23.pdf>

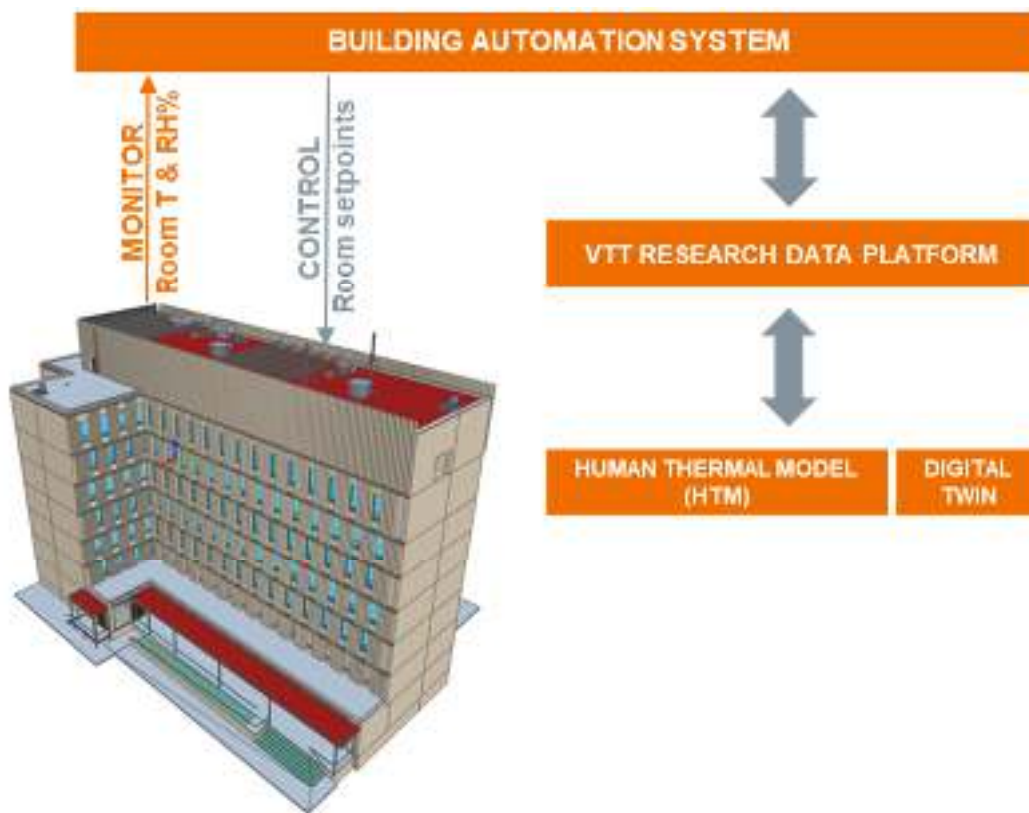
Fictional person types developed for tackling GDPR related privacy issues



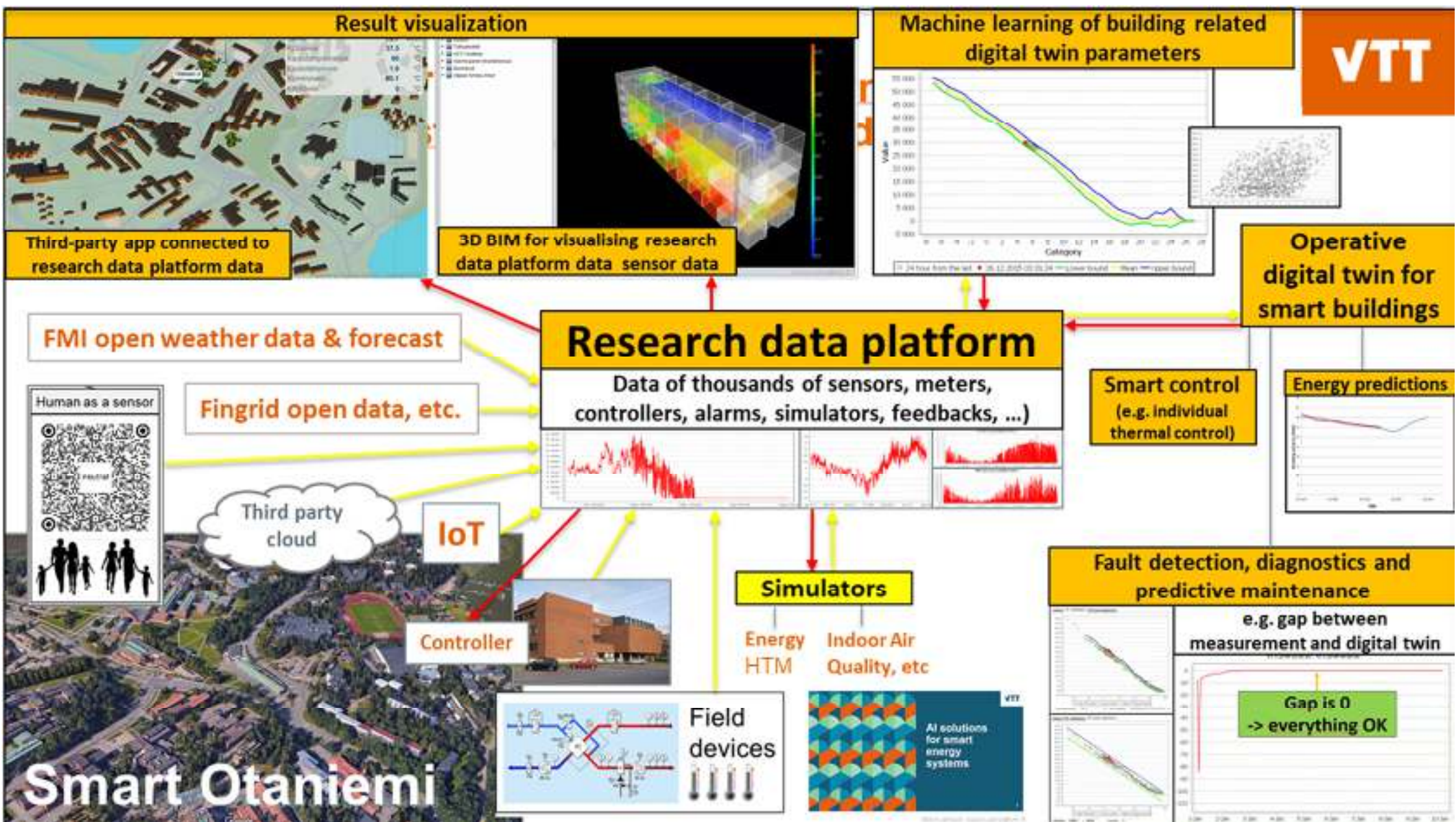
- Also individual body composition measurement based approach (GDPR needed)

Technical solution for HTM Control

Human Thermal Model (HTM) & Building interactions



- Monitor: Model needs indoor air temperature and relative humidity values from room sensors.
 - via BMS APIs,
 - or via standard field bus level protocols
 - or via IoT sensors
- Control: Model needs access to change room temperature controller temperature setpoint value
 - via BMS APIs,
 - or via standard field bus level protocols
 - or via smart IoT radiator thermostats



Examples of VTT research data platform supported BMS (BACS, HEMS), standard protocols and IoT products



Sample HTM results

Online dashboard for continuous monitoring selected person thermal comfort in selected space

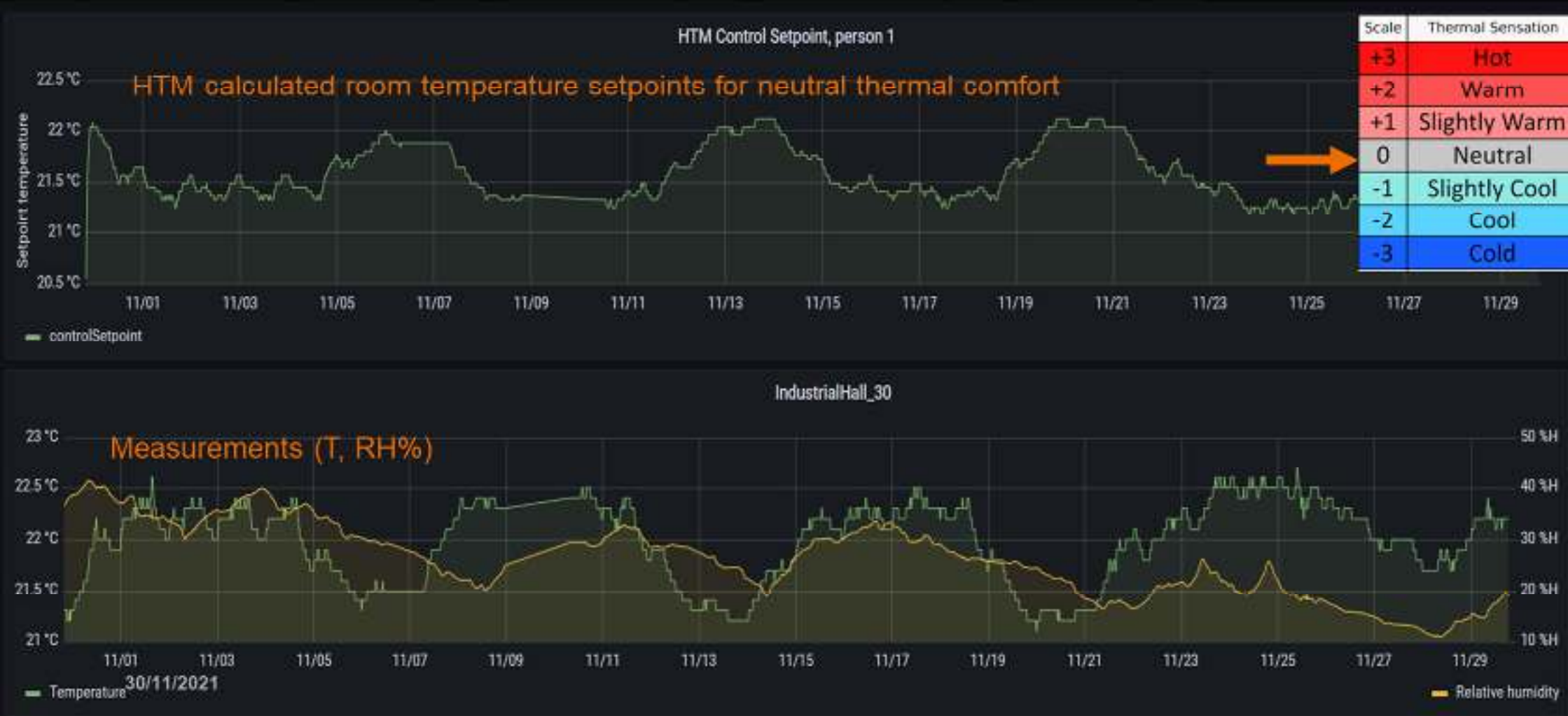
Scale	Thermal Sensation
+3	Hot
+2	Warm
+1	Slightly Warm
0	Neutral
-1	Slightly Cool
-2	Cool
-3	Cold



Fictional persons info

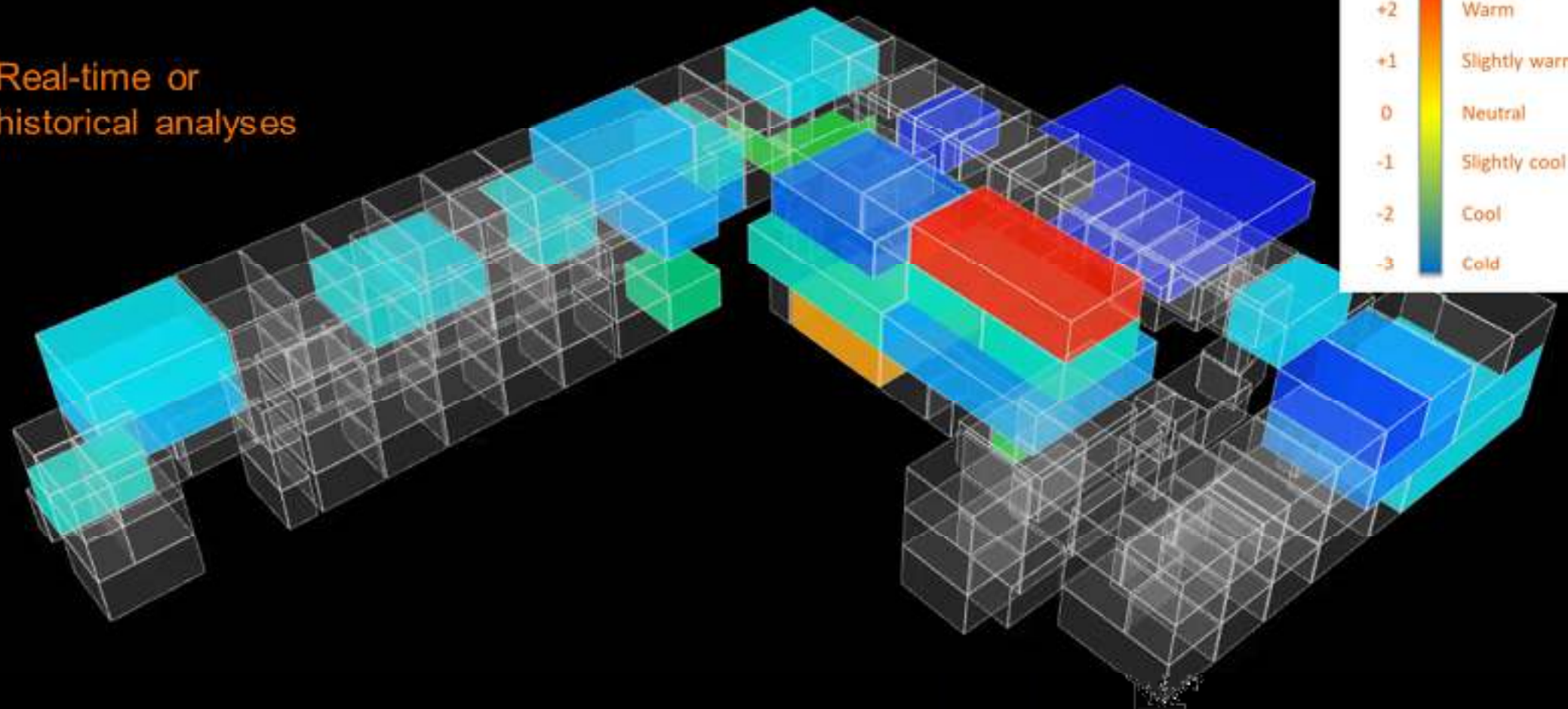
ID	Gender	Age	Weight	Height	BodyFatAsPerCent	ExerciseLevel	HeartRate	Rest
2	MAN	50.00	76.56	1.75	23.20	TOLERABLE	70.00	

Online dashboard for continuous calculating optimal room temperature setpoint for selected person in selected space



3D BIM based visualising individual thermal comfort in different spaces by Human Thermal Model (HTM)

Real-time or
historical analyses



bey⁰nd

the obvious

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