kentyou

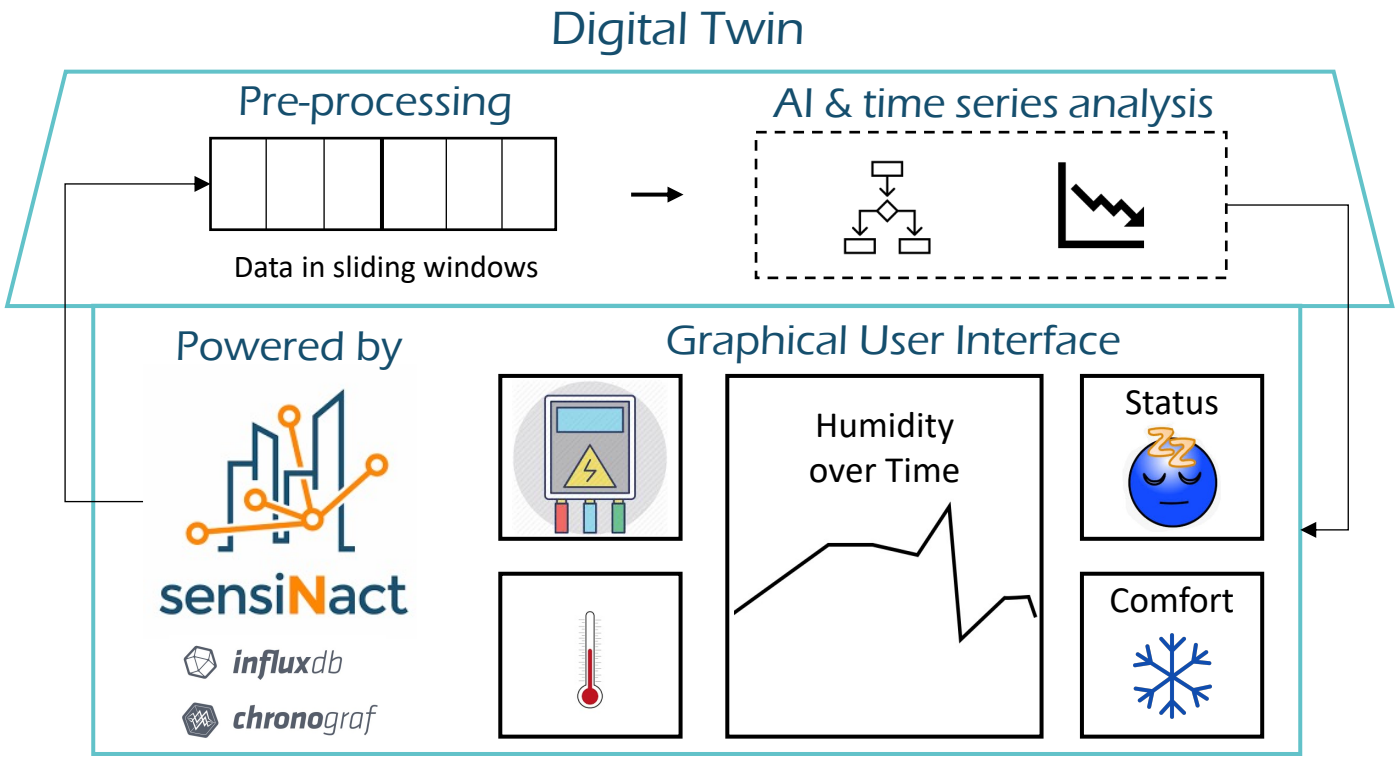
Occupancy and Comfort Inference

DVC Energy Theme, CERTH

REACH

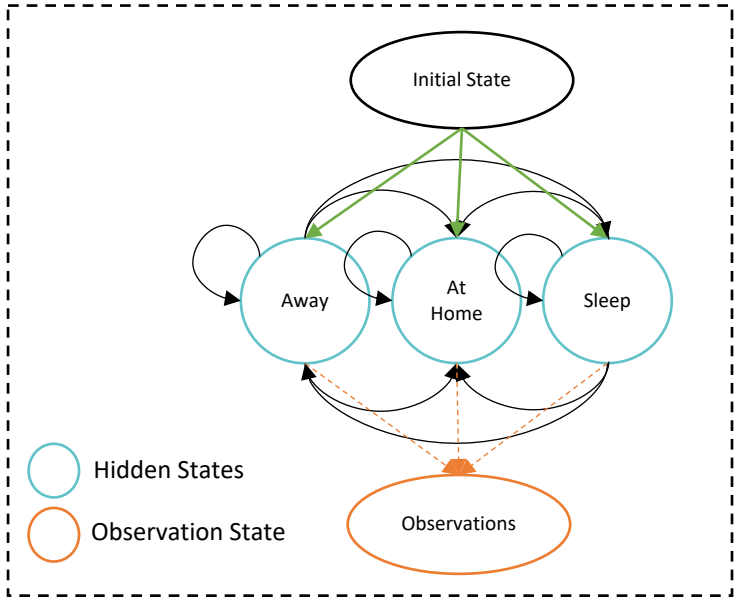
Overall Architecture

- Digital Twin, based on sensiNact IoT platform
  - Pre-processing: Cleaning, filtering, enrichment of data in sliding windows
  - AI & time series analysis: Occupancy and Comfort Inference
  - GUI: Real time monitoring, Historical data exploration



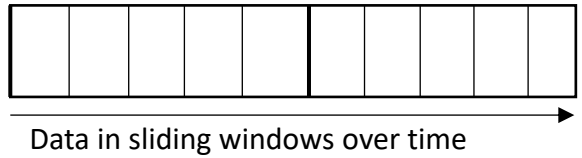
Occupancy Inference

- Hidden Markov Model
  - Finite number of occupancy states
  - Next state depends only on the current one – no memory of past
  - Hidden states inferred by non-intrusive sensors data



Away	At Home	Sleep
0.2	0.6	0.2

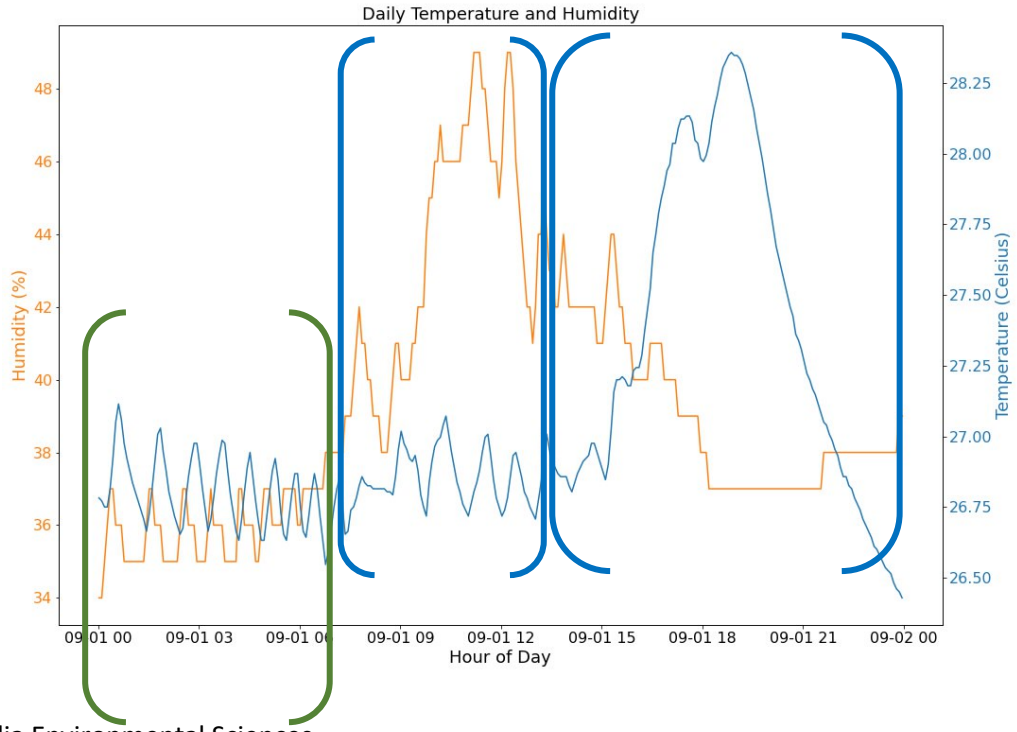
	Next State			
Current State		Away	At Home	Sleep
	Away	0.8	0.15	0.05
	At Home	0.1	0.8	0.1
	Sleep	0.1	0.5	0.4



+ ***Viterbi Algorithm***

Comfort Inference

- Thermal comfort (neither too cold nor too hot)
  - Affected by temperature, humidity, occupancy, time of the day
- Time series (drift) analysis to recognize periods
  - Steady and Changing
- Comfort Inference for each period
  - Rule-based logic [1, 2] considering *occupancy* results and *environmental* data



[1]: N. Brelih, Thermal and acoustic comfort requirements in European standard and national regulations
[2]: P. Antoniadou et al. Evaluation of Thermal Sensation in Office Buildings: A case study in the Mediterranean. Procedia Environmental Sciences.

Advancements

Reproducibility

- Already tested in another testbed for occupancy estimation
- Need for re-training on data of each testbed
- Not expensive

Reliability & Trustworthiness

- Reached up to 80% accuracy in indoor occupancy estimation
- Unintrusive sensors and non private data
- Secure data transmission

Scalability

- Training may be performed using data in smaller time intervals and cloud capabilities
- Inference will be achieved on-premise

Risk Management

Risk	Response
Low accuracy	Study various window's lengths
Lack of annotated data - KPI on accuracy cannot be evaluated - Inability to train HMM	Train using Kentyou's dataset and test on CERTH's data Explore unsupervised techniques which do not require annotated data