European Master on Advanced Robotics+

Title

An energy saving room scheduling system for smart hotels

Group project supervisor(s): Names here.

Motivations and general objectives

Reducing energy consumption and the carbon footprint is a need of any industry, and the hotels make no exception [1]. Substantial savings, typically require conspicuous investments in infrastructures (e.g. thermal insulation). A complementary approach works on the operations [2, 3, 4]. The high level of automation and ambient intelligence technology, which are increasingly spreading in many hotels around the world [5, 6], offer a new leverage point that can be exploited.
A question arises: is it possible to save energy in a hotel by means of an optimal scheduling of rooms? In other words, is it possible to allocate rooms to customers in order to minimize the heat dissipation towards the outside?
Preliminary results [7] show that not only it is possible but that savings are also relevant.
This group project is dedicated to further investigate strengths and limitations of this approach and, eventually, improve it.

Proposed work plan

The plan requires the students to:
1. become familiar with the adopted theoretical concepts: heat dissipation linear model, hotel topology, mathematical programming formulations
2. get to grip with the existing software tools (Open Studio / E+ simulation model, C++ code w/ Gurobi APIs)
3. assess current literature survey
4. conduct the experiments: campaign design, instances generation, automation, results collection and analysis

Optional steps can be any of:
- Complexity analysis of the problem
- Improvements of the optimisation approach

The students are expected to document obsessively any step.

Expected results

The output of the project will be a more solid validation of the energy performance of the approach.
The students are expected to learn basic modelling of heat dissipation in buildings, achieve a greater insight in graph theory and mathematical programming with a real

application to smart building automation, and learn how to design and automate an experimental campaign.

The students are welcome to participate as co-authors to an ongoing article.

List of bibliographic references

[1] Scholz, Petr, and Jan Voracek. "Organizational culture and green management: innovative way ahead in hotel industry." Measuring Business Excellence 20.1 (2016).
[2] Lee, Dasheng, and Chin-Chi Cheng. "Energy savings by energy management systems: A review." Renewable and Sustainable Energy Reviews 56 (2016): 760-777.
[3] Perea, E., et al. "A novel optimization algorithm for efficient economic dispatch of Combined Heat and Power devices." Energy and Buildings 111 (2016): 507-514.
[4] Dounis, Anastasios I., and Christos Caraiscos. "Advanced control systems engineering for energy and comfort management in a building environment—A review." Renewable and Sustainable Energy Reviews 13.6 (2009): 1246-1261.
[5] Carneiro, Davide, and Paulo Novais. "New Applications of Ambient Intelligence." Ambient Intelligence-Software and Applications. Springer International Publishing, 2014. 225-232.
[6] Stavropoulos, Thanos G., Dimitris Vrakas, and Ioannis Vlahavas. "A survey of service composition in ambient intelligence environments." Artificial Intelligence Review 40.3 (2013): 247-270.
[7] Andrea Congiu, Design and validation of an energy saving technique in hotels via algorithms for optimal allocation of rooms (Progettazione e validazione di una tecnica per il risparmio energetico in alberghi mediante algoritmi di allocazione ottima delle camera), Master thesis, Università degli Studi di Genova (2014)

Short description of the hosting laboratory

EMAROlab is the multidisciplinary lab born within the EMARO+ context

Projects / Companies / Universities involved:

- Università degli Studi di Genova
- Sargo Soc. Coop.

Contacts

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