HVAC OPTIMIZATION WITH ARTIFICIAL INTELLIGENCE

Application for the marine industry -

digital services for real-time analysis, smart monitoring and optimization to retrofit HVAC systems

SUMMARY

Cooling and heating processes (HVAC) consume energy. In the maritime sector energy consumption is an important part of the cost structure. With AI technologies existing HVAC solutions can be optimized by retrofitting. HVAC control based on model predictive control yields up to 10% energy consumption reduction.

CURRENT SITUATION

The obtained estimates show that around 80% of HVAC systems use Proportional–Integral–Derivative controllers (PID) for modulated control. The PID control logic is easy to implement. However, experience shows that in most cases it lacks efficiency in its control method. This is due to the fact that responsive decisions are made reactively.

PROJECT DESCRIPTION

In a cooperation of the marine industry powerhouse Rheinhold & Mahla, Hamburg and the data analytics company Proekspert, Estonia the HVAC system on ferries is analyzed and new solutions are implemented. The aim of the project is to create a model predictive control method. According to this method, grey and black box system identification techniques are used to acquire a model for simulating the future states of the HVAC system. The simulation models enable optimization problem formulation which results in energy savings.

REFERENCES

www.proekspert.de

PARTNERS

PROEKSPERT

TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

R&M
Rheinhold & Mahla
Since 1887

SOLUTION

Proekspert works on a pilot on two “RoPax class” ferries. Combining the maritime domain knowledge and the data analytics experience, a solution was designed that gathers data remotely from the vessels, uses trained models to simulate different control decisions on premise, and sends the optimal decision to a local PLC which communicates the command to a HVAC devices. Despite the fact that only a few months of operational data is available, the prediction models already achieve an impressive accuracy. Temperature in arbitrary rooms can be predicted with an uncertainty of merely 0.2°C. The energy consumption of large devices such as chillers can be clearly linked to weather conditions and the internal configuration such as the chilled water outlet temperature. Using these predictive models as input, a simple control policy was developed that outperforms the current control systems by a margin of 10% of the HVAC energy consumption. The control decisions (such as room temperature setpoint) are computed autonomously, i.e. not requiring human intervention. However, if the need arises, the setpoints can be overridden by the crew.

CONTACT

Tähve Lõpp
Proekspert AS
tahve.lopp@proekspert.de

Andrus Junolainen
R&M Finland, Managing Director
andrus.junolainen@rm-group.com

INDUSTRIE 4.0 – FEATURES

Retrofitting control systems yield energy consumption optimization. The rapid development of IoT technologies allows for easy data collection from existing HVAC systems. This enables building predictive models which help proactively to control the system.

STANDARDIZATION APPROACHES

The simulation models enable the optimization problem formulation but are not standardized. The system integration and interoperability is based on proprietary solutions due to missing standards. Interoperability and information model standards such as asset administration shell can help reducing the integration costs.