A self-learning algorithm that helps save heating energy

September 1 2022

Replacing conventional radiator thermostat sensors with Danfoss Ally smart thermostats is simple and can be done in just a few seconds. Credit: Empa

A thermostat that predictively controls the indoor climate and thereby improves energy efficiency and comfort—Empa researchers Felix

Bünning and Benjamin Huber came up with this idea while working in Empa's Urban Energy Systems lab. They developed a control algorithm that can calculate a building's ideal energy use several hours in advance based on weather forecasts and building data. The first experiments at NEST, Empa's and Eawag's research and innovation building, showed that this approach can save around 25% of the energy.

In March 2022, the two researchers, together with Matthias Sulzer, Senior Researcher at Empa, founded a spin-off company, viboo, to bring the solution to the market. In order to facilitate market entry, however, the algorithm still has to undergo more field tests.

Pilot project in an Empa office building

"We aim to integrate our solution into older buildings with no integrated building management system," explains Benjamin Huber. For this reason, the two neo-entrepreneurs decided to further test their algorithm in older buildings after the successful experiments in NEST. For that, they needed a suitable test object and a partner company that has smart thermostats in its portfolio. Empa's directorate provided the former: an office building, built in the 1960s and renovated in 2009.

The viboo team also found a suitable partner company. "With Danfoss, we were able to win an international manufacturer for the project whose smart radiator thermostats already had a suitable interface. The control values calculated by the viboo algorithm can be transmitted from the cloud to the hardware via this interface," explains Huber.

In a first step, the team replaced 150 existing analog thermostats in the Empa building with a smart solution from Danfoss, the Danfoss Ally. Next, they connected the hardware to the Danfoss cloud. To obtain the control values for the smart thermostats, the Danfoss cloud communicated with the viboo cloud, which ran the self-learning

algorithm. The setup was thus ready for field tests.

The new thermostats controlled the indoor climate from Christmas 2021 to the end of March 2022. In order to be able to draw a comparison, the operating modes were changed regularly, i.e. from the viboo controller to the standard Danfoss Ally mode and back again. At the end of the trial, the team surveyed the users in order to understand how they perceived the room comfort and whether users accept such new solutions in general.

Win-win: Less energy, better comfort

The results of this pilot project were very positive. Overall, energy consumption was reduced by about 23 percent compared to the same heating period of the previous year—with the same or even better user comfort. In comparison, Danfoss Ally alone saved only about twelve percent. "In our surveys, very few users expressed skepticism about the new technology. This makes us confident that the market will eventually accept our solution," says Felix Bünning.

The partner company is also impressed by the initial results. "We see great potential in the collaboration with viboo and think that solutions like this are the future—not only for the control of a single building, but for entire energy systems," states Andrea Cannarozzo, Managing Director of Danfoss AG. From a visionary perspective, the viboo algorithm could in future optimize various smart home integrations such as heat pumps or solar systems, but also help operating the electrical grid or heating networks more sustainably.

More projects already in the pipeline

However, back to the near future. To further pave the way for market

entry, viboo is conducting additional pilot projects in the upcoming heating period—together with Danfoss, but also other manufacturers such as ABB and Schneider Electric. The aim is to collect additional data and put the solution to the test in other environments.

At the same time, there is already interest from the public sector in integrating the algorithm into existing buildings, for example from the Federal Office for Buildings and Logistics (BBL) and the municipality of Männedorf. The work at Empa is not yet finished for viboo and Danfoss either. In the future, the partners will equip further buildings on the Empa campus with their smart solution.