NudgeFlow: The next generation of residential ventilation - tweaking the natural air flow with distributed components

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ABSTRACT

The residential ventilation market has found itself in a constant shift in its performance requirements in the last few years. During the SARS-Cov2 pandemic, the focus was on indoor air quality (IAQ) centred performance and changed during the energy crisis, to minimize the energy use. In addition, the emphasis on renovation solutions has challenged the applicability of the traditional prescriptive ventilation standards and is pushing the market towards performance-based design. Moreover, the limited space available for ventilation ducts in renovation has led to a renewed focus on natural and hybrid decentralized ventilation solutions.

Out of this context, we envision the next generation in residential ventilation system that is smart, robust, requires minimal intervention in existing dwellings and guarantees a good IAQ and low energy use. The NudgeFlow system dynamically nudges and tweaks the natural flow pattern through the different spaces in the dwelling to satisfy the instantaneous ventilation needs and flexibly adapt to the prevailing climate conditions. This novel ventilation system consists of interconnected local low pressure drop ventilation components, sensors tracking ventilation demand and climate conditions and a distributed controller adjusting the operation of these components.

The project aims to advance NudgeFlow concept by conducting research to understand airflow patterns, to establish a performance evaluation method, to find optimal design configuration(s) of the components, and to develop a control framework. A virtual test bed will be developed to demonstrate the system's feasibility and performance.

KEYWORDS

Residential ventilation, airflow patterns, performance, control framework, design