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Operation Planning Method for Home Air-Conditioners Considering Characteristics of Installation Environment

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Abstract—Home energy management systems (HEMSs) are the system to manage the energy usage in houses. The use of HEMSs, and especially those which are capable of automatically controlling home energy appliances such as air-conditioners (ACs), is expected to manage energy utilized in domestic field effectively. In the present study, we focused on automatic AC operation by HEMS with the combined goal of improving thermal comfort while reducing electricity costs. In general, the room temperature and electricity consumption of an AC are highly dependent on the characteristics of the installation environment, so that the derivation of an appropriate AC operation plan is generally a difficult task. To tackle this problem, an energy management method to provide AC operation plan tailor-made for the target AC installation environment by learning the characteristics of the installation environment (CIE) from the historical operation result data is proposed. The efficacy of the proposed method is verified via numerical and real-world experiments.

Key words — Home Energy Management System (HEMS), Smart House, Air conditioner (AC), Operation Planning, Machine Learning, Support Vector Regression (SVR), Particle Swarm Optimization (PSO), Predicted Mean Vote (PMV), Characteristics of Installation Environment (CIE), Real-world Experiment

1. Introduction

Home energy management systems (HEMSs) are the system to manage the energy usage in houses. The ordinary HEMSs mainly possess functions such as monitoring and visualizing energy consumption information, and automatically controlling home appliances. Occupants expect HEMSs to improve the comfort of occupants and reduce the electricity cost in houses according to the situation. Consequently, in Japan, HEMSs are gradually spreading and the Japanese government has set a goal of installing HEMSs in all homes by 2030 [1]. In the domestic field, new types of many electrical appliances are steadily being introduced, so that the electric energy is consumed for various purposes, and the electricity cost in the house would be increased in many houses. If HEMSs could control home appliances appropriately considering the given tariff structure, then significant reductions in electricity cost could be realized.

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