Heterogeneous service management system for the Smart Home

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Extended Abstract

In recent years, all kinds of devices have been networked, smart homes have been widely recognized by miniaturization of sensor devices and wirelessization. In addition, the movement to use ICT technology to deal with energy problems has become more active, and the expectation for HEMS (Home Energy Management System) which is energy management technology in the home is increasing. In addition, at the same time, the development of sensor devices has increased expectations for services that improve in-house comfort. Research and development of systems to realize these have been done for a long time, but most of them have realized only a single or first set service. This is because the purpose of each service is not always compatible and often conflicting. Therefore, in this research, we aim to realize operation prediction of engine cogeneration system that simultaneously satisfies energy efficiency and comfort at smart home. What kind of situations will occur when multiple services are activated Implement optimum operation of equipment by making predictions by utilizing a simulator at any time. Since the situation in the house changes not only with the state and physical quantity of the equipment but also the sense and intention of the living person, we optimize the operation of equipment by conducting simulation including human behavior.

In this study, we modelled energy use efficiency and thermal environment to predict appropriate operation of engine cogeneration system. For energy efficiency improvement, we examined the optimal operation problem of the engine cogeneration system, which was cited as a measure for promotion as a new energy countermeasure in the Kyoto Protocol. Generally, household engine cogeneration systems are said to be difficult to forecast energy demand unlike commercial systems. This is because household energy demand is easily influenced by residents' behavior. Residents' lifestyle patterns are not the same, it is also a problem that demand changes in a short time of 1 minute or less. Normally, in domestic cogeneration systems, cogeneration operation time is decided according to the heat demand of the schedule predicted at the time of operation planning, but energy demand also differs greatly depending on the days of the week, and when the schedule is different even on the same day, It will fluctuate and become a problem. In addition, although the heat outputted by this system can be stored as hot water in the hot water tank, it can not be used to store electric power, so it is used in the home. If it is not used in the home, it will be recovered

as heat as an electric heater, but because the overall efficiency will decline, the generated electricity should be consumed in the household. We modelled each of these problems and conditions against energy.

Next, in comfort modelling in a thermal environment, we modelled PMV (Predicted Mean Vote: predictive average cool temperature feeling declaration) which is a comfort index. The comfort in the house is concretely a sound environment, a light environment, a thermal environment, and the like. In the sound environment, quietness as typified by noise etc. is an important index, and in the light environment it is necessary to keep safety while keeping things clearly visible. Safety here is not to cause light hypersensitivity seizures or the like which show an abnormal reaction with respect to light stimulation coming into the eye. In addition, the thermal environment consists of various factors such as heat, cold, indoor air current. Among them, we will focus on the thermal environment where the influence on the human body is large. The comfort in the thermal environment is that it is not hot and cold in the house and it does not feel thermal discomfort. Also, since comfortable feeling varies depending on the person, an acceptable thermal environment is defined as an environment that can be tolerated by people of 80% or more of the resident. In addition, in the thermal environment, it varies depending on the difference in temperature due to the material of the inner wall, as well as various conditions such as behavior of residents and clothes, age gender. As described above, elements that affect the temperature regulation of the human body are defined as "thermal environmental elements", among which the activity amount affecting the human body, the clothing amount, the air temperature, the radiation temperature, and the humidity , Airflow total of six elements. PMV is a thermal indicator that can quantitatively handle these six elements.

The cogeneration system targeted this time determines the operation time of the cogeneration system by considering only the heat demand rather than the energy efficiency. However, in order to sufficiently satisfy the comfort, the operation of a thermal device such as an air conditioner is indispensable, and such a thermal device consumes a lot of electric power. In such a case, if the cogeneration system is operated for power demand, the overall cost will rise. Therefore, in order to investigate the relationship between electricity demand and comfort, three levels of $\pm$ 0.5, further $\pm$ 1.0, $\pm$ 1.5, which are considered to be comfortable for PMV, which is an index of comfort, were set as target PMV values. As a result, the difference in the power consumption per day due to the difference in the target PMV value was clarified. We believe that this will contribute to collaboration among heterogeneous services with different purposes.