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Efficient Optimization Approach Based on ACO Algorithm for Energy Management in Building Environment

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Abstract. Energy is one of the most important resources. Energy management plays an important role in future energy efficient building environment. In this connection some works proposed to deal with energy efficient buildings. But the tradeoff between occupants' comfort level and energy usage is still a major challenge and remains unresolved. In this paper, we present the energy efficient optimization method based on ACO (Ant Colony Optimization) algorithm for simultaneous comfortable and energy saving in building environment. We have given focus in two directions. First is to maximize the occupants' comfort level and second is to control the usage of power.

Keywords: Energy management, Ant colony algorithm, Comfort index, Energy saving.

1 Introduction

Energy efficiency in building is becoming major interest to the researchers of any scientific. Energy efficiency policy is to consume minimum power without compromising the occupants comfort index. This minimum power consumption without compromising users comfort level is an interesting problem to the research community to cope with. This leads to the trade-off between energy consumption and user comfort level.

Energy conservation in the building is one of the challenging sectors in research field. Due to the recent technological advancements regarding building facilities many approaches are available in designing energy conservation system. Research on improving a building environment mainly focuses on occupants' comfort and energy efficiency. Since people spend most of their time in buildings, the environmental comfort conditions of a building are highly related to occupant satisfaction. A control system with an intelligent optimizer is developed, which can be applied to energy and comfort management in the smart and energy-efficient buildings [4]. Hierarchical multi-agent theory is used to build this control system, which contains agent-controllers at the lower level. Particle Swarm optimization (PSO) is adopted to optimize the set points of the control system during system operations. There is a

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survey exploring state of the art control systems in building. Attention was focused on the design of agent-based intelligent control systems in building environments [5].

In this paper, we proposed energy efficient optimization approach based on ACO algorithm for energy management in building environment. This approach consumes less energy without compromising users comfort in building environment. We consider the fundamental three parameters such as thermal comfort, visual comfort and air-quality which determine occupants' quality lives for comfort index in a building environment. This comfort index indicates occupants' comfort level.

2 Optimization Approach Based on ACO Algorithm

Fig. 1 illustrates the block diagram of the proposed optimization model for energy management in building environment. This model has the ACO optimizer, user comfort index, coordinator agent, fuzzy controllers, comparator, and building actuators and sensors.

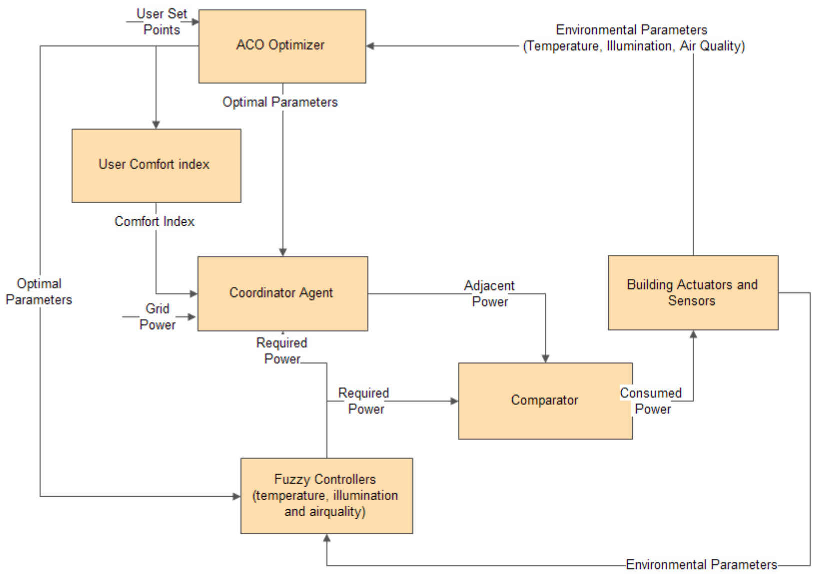

Fig. 1. Efficient optimization approach based on ACO algorithm for energy management in building environment

The ACO optimizer has environmental parameters such as temperature, illumination and Air-quality are input to the ACO for optimization. User comfort index can be calculated using Eq. 1 [2]:

$$Comfort = \alpha 1[1 -(eT / Tset)2]+ \alpha 2[1 -(eL / Lset)2]+ \alpha 3[1 -(eA / Aset)2] \quad (1)$$

Where “comfort” is the overall comfort level of the user and is ranged between [0,1]. α_1, α_2, α_3 are the user defined factors which solve any possible conflict between the three comfort factors (temperature, illumination and air-quality).

Fuzzy controller takes as input the error between real parameters and optimal parameters of the ACO. The output of the fuzzy controller is the required power for temperature, illumination and air-quality control in the building environment. Coordinator agent takes as input the required power to the building from fuzzy controller, and optimal parameters from the ACO. It then adjusts the power on basis of the available power, required power and user comfort index. The adjusted power is then compare with the required power to get the actual consume power. Then actual consume power is given to the actuators to be used. The actual consume power is the minimum power to be consume in the building. Comparator supports the comparison component actually to take as input the adjusted power from coordinator agent and required power from fuzzy controller. It then measured the actual consumed power of the building. Building actuators are the devices which actually use the energy inside the building.

3 Conclusion

In this paper, we present the energy efficient optimization approach based on ACO (Ant Colony Optimization) algorithm for simultaneous comfortable and energy saving in building environment. The proposed ACO based optimized model produces comfort index and consumed power as compared to GA based optimized model.

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