ENERGY EFFICIENCY IN A SMART HOME WITH AN INTELLIGENT NEURO-FUZZY PARADIGM

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Demand Side Management (DSM) program which reduces the load during peak demand periods is known as demand response. A customer can voluntarily participate in demand response to adjust the amount or timing of his energy consumption. By using demand response, we can shift electrical load from peak demand time to other periods, which is usually in response to price signal. In residential level and in a dynamic pricing system where modification of energy consumption is unrecognized by a consumer, using an automated Intelligent Energy Management System (*i*EMS) should be considered. The system should be designed in a way that it is not only able to manage renewable energy resources but is also able to match itself with users' preferences and behaviors. Then, it should be able to find optimal energy scheduling according to the dynamic notion of price. In home level, the approach is to add intelligence to the system and then encourage customers to save energy by changing their energy consumption behavior. Therefore, an intelligent and very reliable system is designed which acts like a human being in critical situations.

For the first step, a new topology of neural network is introduced. It acts as an associative memory and has a crystal type structure, which can be expanded easily. Then, two models for an automated *i*EMS in residential level are presented. The proposed systems have two subsystems: fuzzy subsystem and intelligent lookup table. Intelligent lookup table is used as a way of implementing this paradigm. The fuzzy subsystem has 15 fuzzy rules along with membership

functions which makes appropriate outputs for the intelligent lookup table subsystem. The core of the intelligent lookup table is the proposed neural network. In order to make an intelligent lookup table by the proposed neural network, we create feedbacks from outputs of the network to its inputs. There are some differences between the functionalities and architectures of the two models, but both of them, as their simulations show, are able to find the best energy efficiency scenarios in different situations.

For the last step, some features of the first and second models are combined and the enhanced and final model is presented. Then the connection between the EMS program and the Gridlab-D software is made. The EMS program is able to regulate the energy consumption of appliances based on the different situations and different scenarios. Some smart appliances such as water heater, air conditioner, light, solar panel, battery storage, refrigerator, freezer, dishwasher, washer and dryer are simulated and their energy consumption and cost of the energy with and without the proposed *i*EMS in different areas (north, south, east and west of U.S.) and different times of the year (January and August) for one week are shown and compared.