Abstract

Smart home is a place that equipped with information technology and computing, it can accept as well as respond to the resident's request. The purpose is to provide resident a comfortable, convenient, safe, and joyful life through managing various technologies at home. Smart home system is a thought that supports control of several different systems in a household (e.g., heating, air conditioning, security, lighting, and audio/video systems) and acknowledged under the term smart homes. In this way, the worst condition of energy shortage could happen due to increasing number of consumer electronics and their attractive functions according to the advancement of smart homes. These increased power consumption resources have been forcing the human to search methods for managing power to reduce power consumption in home because power used in the home is a typical example of consumptive one. The high power required by home appliances makes our homes one of the most critical areas for the impact of power consumption. The residential areas are one of the main power consumers today, reducing power in home would contribute significantly to the environment. As more and more home appliances and consumer electronics are deployed, the power consumption in home area (i) tends to increase and (ii) leads an increase in the risk of power blackout. As a result, an intelligent smart home energy management system is needed for smart homes, which is responsible for observing and handling the working operations of home appliances.

This dissertation concerns research of technological issues for design and implementation, evaluation and stability problems. These problems are important application domains of smart homes. The overall objective of this dissertation is to develop the application of power and stability control for smart homes, which reduces the risks of peak power consumption to prevent power blackout and maintain power system stability in the presence of time delay. The stability analysis problem treated in this research is to determine the upper bound for time delay so that the system is globally stable.

Design and implementation part addresses the basic components for proposed system model such as smart home energy management system, smart electric sensors, power provisioning controller and smart appliances. Then the system is designed with the characteristics of sensing and computation, adaptability, autonomy and executing timeliness. The performance of the system is analyzed in terms of home appliance power consumption patterns, priority rule for available power sharing among appliances and stable region identification for which the system is stable. The simulation results show the appliance power consumption behavior when the available power supply is limited. Simulation results also help in defining stable/unstable and overshoot/non-overshoot region. The stability analysis verifies that the system stability is dependent on some time delay. Moreover, the peak power consumption of heterogeneous home appliances can be guaranteed for maintaining available power limit.

To evaluate the proposed system, the validation of the system is shown with both simulation and experiment results. First, the real house based power control simulator is developed with Visual Studio. Second, the stability analysis has been carried out for overall power system with MATLAB.

This proposed research can help the development of smart home system to prevent power blackout and guarantee the maximum power consumption within the available power limit. Moreover, it can provide optimal system design of power assignment among home appliances and implementation of stability test with delay consideration. This research can give better solutions for inhabitants who are seeking to get maximum appliance utilization with fast system response and customer satisfaction.

keyword: home energy management system, power control, stability control, power provisioning controller, smart electric sensor.