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Smart home system: integration of energy facilities and environmental factors

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Abstract

This paper concerns the soft-in soft-out detection in a coded communication system, where the transmitted symbols are discrete valued, and the exact a posteriori probability (APP) detection often involves prohibitive complexity. By using the properties of Gaussian functions, an approximate approach to the APP detection is devised with the idea that, in the computation of the APP of each symbol, the remaining symbols are distinguished based on their contributions to the APP of the concerned symbol, and the symbols with less contributions are approximated as (continuous) Gaussian variables [hence the name partial Gaussian approximation (PGA)] to reduce the computational complexity. The connection between the PGA detector and the reduced dimension maximum a posteriori detector (RDMAP) is investigated. It is shown that, PGA is equivalent to RDMAP, but it has a complexity much lower than that of RDMAP, i.e., PGA can be regarded as an efcient implementation of RDMAP. In addition, the application of PGA in intersymbol interference (ISI) channel equalization is also investigated.We show that PGA allows further signicant complexity reduction by exploiting the circulant structure of the system transfer matrix, which makes PGA very attractive in handling severe ISI channels with large memory length.

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Smart Home System: Integration of Energy Facilities and Environmental Factors

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Abstract

This paper proposes a power smart home system to manage and coordinate electricity consumption of household appliances and local power generation with consideration of the status of smart grid, weather forecast, and occupants' activities plan. The smart home system orchestrates electricity facilities and environmental factors to achieve an overall financial benefit. The proposed smart home system is a central point to manage and coordinate energy related activities at residential homes. It has the capability to take the advantage of the variable price of a smart grid and maximize the benefit of local power generation. It supports occupants of residential homes to reduce electricity cost by scheduling and rescheduling consumption of household appliances with running flexibility. The system architecture is presented with details of communication network, data storage, and system modules. The proposed architecture provides a solid foundation for evolving smart home system in its implementation in the reality.

1. Introduction

Smart home technology targets residential buildings with facilities and devices that can communicate with each other and perform a variety of tasks with "ambient intelligence" [1,2]. It covers extensive technical advances that can bring intelligent features for homes in response to residents' needs in terms of management for energy efficiency, services for comfort and convenience, provision of home-based healthcare, and assistance to elderly or disabled people etc. In this paper, we focus on energy-related smart home technology with highlights on renewable energy sources [3], smart electronic appliances [4], smart grids [5], and robust forecasting and monitoring [6] of environmental factors.

As renewable energy sources such as solar power and wind grow fast as a percentage of overall power supplies, smart grids have become a promising means of the integrated management of electricity demand and supply. Smart grids technologies focus on digitally enabled electrical grid that collects, analyzes, and acts on information according to dynamic status of both suppliers and consumers in order to improve the efficiency and reliability of electricity services. Most of existing research of smart grid targets the achievement of decentralized coordination for networks of planners and controllers. The power supply and demand are considered at a coarse granularity level without considering the details of energy usages and renewable energy sources of individual homes.

Smart appliances utilize modern computer and communications technology to make functions faster, cheaper and more energy-efficient. The smart appliances can take advantage of an energy "smart grid" and contribute to load management in future energy systems with larger shares of renewable energy. Most of initiatives and proposals about smart appliances emphasize individual appliances with new capability to adapt smart grid technologies. It is still lacking of solutions to consider the complex relationships of multiple appliances, local renewable energy resources, and environmental factors.

Most of existing building energy management systems or software focuses on commercial buildings. These systems are designed for the automated control and monitoring of those electromechanical facilities in a commercial building which yield significant energy consumption such as heating, ventilation and lighting installations. The emerging technologies of smart home appliances and renewable energy sources from residential homes are beyond their concerns.

The residential homes are undoubtedly one of the main energy consumers. Existing solutions consider the power supply and consumption at a coarse granularity level where the details of smart appliances, sustainable energy sources, and environmental factors have not been taken into account.

The emerging technologies of sustainable energy sources, smart appliances, electricity sub-meters, and accurate monitor and prediction of environmental factor are summoning a robust solution with sophisticated consideration of the complex and complicated relationships of appliances, renewable energy sources, and external power suppliers. It is highly necessary to develop innovative models and frameworks which have the capabilities to manage and coordinate power consumptions and sources with the support of emerging technologies of ubiquitous computing, sustainable energy sources, smart appliances, electricity sub-meters, and accurate monitor and prediction of environmental factors. A scheduling scheme has been proposed in our previous work [7] for smart home electricity management.

In this paper, we propose a power smart home system as a central point to manage and control electricity consumption of household appliances and local power generation in the context of smart grid. The proposed system can help home occupants to easily manage and control devices and activities related with electricity consumption/generation and reduce electricity cost of a residential home. The proposed solution collects real data of electricity consumption and generation in the residential home and uses the collected historical real data to help the scheduling of electricity consumption and generation at the residential home. The system architecture will be presented with details of communication network, data storage mechanism, and system modules.

The paper is organized as follow. Section 2 discussed assumptions and the context of power smart home management. Section 3 presents the system architecture for power smart home management with details of communication network, data storage, and system modules. Section 4 provides the description of day-ahead static scheduling and runtime rescheduling of electricity consumption and generation at a residential home. Section 5 overviews some related work. Section 6 concludes this paper.

2. Power Smart Home Management

This section discusses the context of power smart home control and management and provides an example of electricity facility and household appliances at an Australian residential home to illustrate the research motivation of this work.

2.1 Residential Homes on Smart Grid

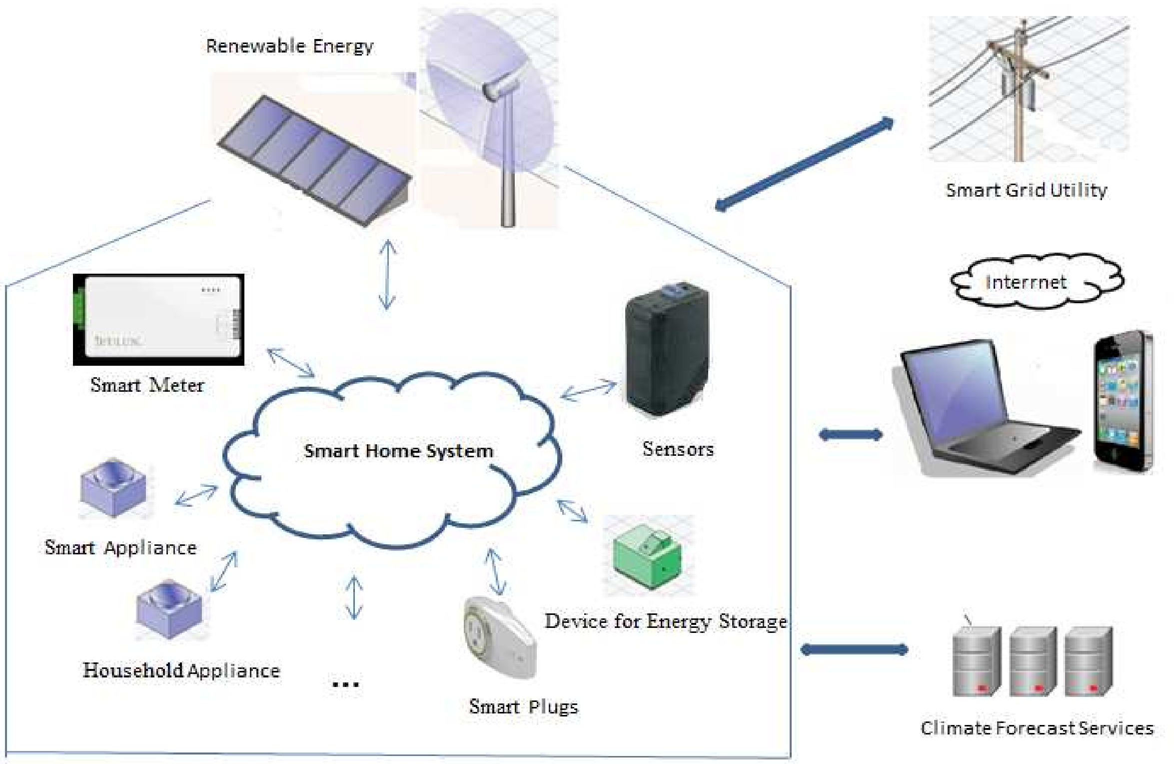

Fig.1. Power Smart Home System

Figure 1 shows the target smart home system in the context of smart grid and local renewable energy resources. The residential home is linked with smart grid utility to buy or sell electricity power. Home occupants can monitor and control home electricity facilities through computer and/or smart phones over the Internet. The residential home has local renewable energy resources, electrical appliances, and energy storage. Some of electrical appliances may be smart appliances which can provide power consumption forecast for each requested program and/or be able to adjust power consumption behavior to take the advantages of smart grid. The sensors can help to monitor the home environment and provide evidences for further control and management. The smart meters are able to collect and provide electricity consumption data at the home. Smart plugs can provide on/off control and power sub-metering for appliances that are connected to. The smart home system will combine ubiquitous computing and centralized computational intelligence to help home occupants manage electricity related activities and dynamically interact with home electricity facilities. There are the following assumptions for the smart home system targeted in this research:

- The residential home is connected with a smart grid that is capable of bidirectional power flow and has varying electricity price.
- The residential home has renewable electricity resources such as solar PV and wind turbine which are dependent on environmental factors such as weather conditions.
- The residential home has a set of household appliances that consume the electricity. The electricity consumption of these appliances are dependent on predictable occupants' behavior and environmental factors such as weather conditions.
- Home occupants have full control of their own electricity consumption and local electricity generation.
- Some requested electricity consumption has a degree of flexibility such as flexible time frames of execution.
- Home occupants have the access of the smart home system to monitor, schedule, and control electricity facilities at the smart home.
- Environmental factors are available, for example, local weather forecast is accessible.
- It may have smart plugs, sensors, and smart meters to monitor and control power related activities at the residential home.

2.2 Electricity Facility and Household Appliances

This subsection provides an example of residential home in an independent house at Australia with a set of electricity appliances. It is assume that the residential home is linked with a smart grid and it has solar PV as its local electricity resources. In order to give readers some ideas of possible quantitative facts, the specifications with real figures rather than generic description of smart grid, solar PV, and household appliances are provided.

The smart grid utility has a variable electricity price for selling power to residential home. Here the "PowerSmart Home" plan [8] of Energy Australia is assumed to be the tariff scheme of the smart grid. The Peak time is 2pm - 8pm on working weekdays with use tariff 52.5470 cents/kWh. The Shoulder time is 7am - 2pm and 8pm - 10pm working weekdays and 7am - 10pm on weekends and public holidays with use tariff 21.3400 cents/kWh. The other time is off peak with use tariff 13.0900 cents/kWh. It is almost sure that electricity tariffs of the future's real smart grids will be more dynamic than above tariffs according to different time-periods.

A solar photovoltaic system with 3kW peak output is installed at the residential home and it is the only local renewable energy resource. Due to the existence of local electricity generation by solar PV, there is chance for the home to sell power to the smart grid. In this work, it is assumed that the price gap between buying and selling power from the smart grid is a constant value as 5cents/kWh.

As an example of a typical residential home in Australia, it is assumed to have multiple household appliances which are connected to the smart grid with smart plugs. A ZigBee Panel Meter from JetLun

[9] is installed at the residential home. With the help of smart plugs, the smart meter has the capability to collect and provide energy consumption data of individual household appliances. Some of these appliances may have running flexibility based on specific constraints. These appliances are connected to smart plugs and can be switched on/off by commands from smart home system. More details are:

- There is a dishwasher with power 1.5kW. The washing time is 40 minutes. As default, the starting time is flexible but dishwashing task must be completed in the specified 24 hours period.
- Swimming pool pump is used for poll maintenance with 1.1 kW power. The swimming pool pump will run 8 hours as total each day. As default, it can run at multiple time periods with constraint as that each period must be at least one hour This must be completed in the specified 24 hours period.
- An automatic washing machine runs with 500 W and cloth dryer runs with 3kW. The washing time is half hour. The dryer running time is 1 hour. As default, it can have a flexible starting time and the cloth washing and drying should be consecutive activities.
- There is a central air conditioning system with maximum power 3kW. The air conditioning system runs according to climate conditions and occupants' requirements.
- There is a smart electricity refrigerator/freezer with 400 W. Normally, this energy consumption is not affected by the target energy management.
- There is a range of electrical lamps that are switched on/off according to lighting requirements of home occupants.
- There are other electrical devices such as TVs, computers, alarms, etc. These devices run according to occupants' home activities.

3 System Architecture

The details of electricity facility and household appliances in a typical Australian independent house have been provided in last section as a motivation example. This section presents the system architecture for power smart home management to deal with the motivation example. The proposed solution for power smart home management will be under a centralized architecture. The household appliances, local renewable energy generators, smart grid utility will be connected by the home network and controlled by smart home system. The smart home system also has the capability to get information from weather services and receive messages from remote computers and smart phones for home occupants to control or monitor the status of local power generation and electricity consumption by household appliances. The smart home system has the capability of static scheduling and runtime rescheduling for electricity consumption and local generation at a residential home to minimize the total cost of electricity power while satisfying power requirements. The communication network, data storage, and system modules will be described in this section.

3.1 Communication Network

The smart home system needs to communicate with devices/services outside or inside the residential home. The communications between smart meters and smart grid utility will be supported by the Wide Area Network of the smart grid. The Internet technology is employed to enable the communication between the smart home system and applications on computers/smart phones and weather services. At the residential home, it is not necessary to have a home area network with a wide bandwidth for high communication speed. Communication needs between smart appliances, smart plugs linked with household appliances, local power generators, sensors, smart meter, and the smart home system can be handled with low cost, low power, low data rate, and short distance technologies such as IEEE 802.15.4 - ZigBee, IEEE 802.15.1 - Bluetooth, IEEE 1901 - HomePlug. As a wireless mesh network, ZigBee has a high reliability and low cost deployment capabilities; in particular, it is convenient to interface with smart metering and smart appliance purposes. In the proposed power smart home system, ZigBee is employed as the home networking solution.

3.2 Data Storage

A permanent data storage mechanism is crucial in the development of power smart home system. The power smart home system aims to reduce the electricity cost at a residential home by scheduling the power demands according to a rich set of power related data that describe the dynamic status of smart grid, local power generation, energy consumption of household appliances, sensor data, weather data, and occupants' activity data. A "PowerDB" database implemented by MySQL is proposed to store these data and support queries from the smart home system. The "PowerDB" takes the responsibility as the central point for electricity related information at the residential home to be collected, organized, and searched.

Smart Grid: "*Smart_Grid_Tab*" is the table in "PowerDB" for smart grid related data. It has data fields "*time_point, tariff, current, voltage, power_consumption*". The data is collected by the installed ZigBee Panel Meter with time interval of 15 minutes.

Air Conditioning: "*Air_Conditioning Tab*" is the table in "PowerDB" for data of air conditioning. It has data fields "*appliance_id, time_point, on_off, mode, current, voltage, power_consumption, temperature_setpoint*". The air conditioning data is collected with time interval of 15 minutes.

Swimming Pool Pump: "*Swimming_Pool_Pump_Tab*" is the table in "PowerDB" for swimming pool pump data. It has data fields "*appliance_id, time_point, on_off, mode, current, voltage, power_consumption*". The data is collected by the installed ZigBee Panel Meter with time interval of 15 minutes.

Dishwasher: "*Dishwasher_Tab*" is the table in "PowerDB" for dishwasher data. It has data fields "*appliance_id, time_point, on_off, mode, current, voltage, power_consumption*". The data is collected by the installed ZigBee Panel Meter with time interval of 15 minutes.

Washing Machine: "*Washing_Machine Tab*" is the table in "PowerDB" for washing machine data. It has data fields "*appliance_id, time_point, on_off, mode, current, voltage, power_consumption*". The data is collected by the installed ZigBee Panel Meter with time interval of 15 minutes.

Cloth Drier: "*Cloth_Drier_Tab*" is the table in "PowerDB" for cloth drier data. It has data fields "*appliance_id, time_point, on_off, mode, current, voltage, power_consumption*". The data is collected by the installed ZigBee Panel Meter with time interval of 15 minutes.

Refrigerator/freezer: "*Refrigerator_Freezer_Tab*" is the table in "PowerDB" for refrigerator/freezer data. It has data fields "*appliance_id, time_point, on_off, mode, current, voltage, power_consumption*". The data is collected by the installed ZigBee Panel Meter with time interval of 15 minutes.

Electrical Lamps: "*Electrical_Lamps_Tab*" is the table in "PowerDB" for electrical lamps data. It has data fields "*appliance_id,, time_point, on_off, mode, current, voltage, power_consumption*". The data is collected by the installed ZigBee Panel Meter with time interval of 15 minutes.

Other Devices: "*Other_Devices_Tab*" is the table in "PowerDB" for other devices data. It has data fields "*appliance_id, time_point, current, voltage, power_consumption*". The data is collected by the installed ZigBee Panel Meter with time interval of 15 minutes.

Weather Observation: "*Weather_Observation_Tab*" is the table in "PowerDB" for weather observation data. It has data fields "*local_date_time, air_temperature, relative_humidity, cloud, delta_temperature,wind_dir,wind_spd_kmh, dew_ point*". The data are obtained from broadcast service of weather observation on the Internet [10]. The time interval is 10 minutes.

Weather Forecast: "*Weather_Forecast_Tab*" is the table in "PowerDB" for weather forecast data. It has data fields "*local_date, cloud, sunrise_time, sunset_time, air_min_temperature, air_max_temperature, relative_humidity, wind_dir, wind_spd_kmh, dew_point*". The time interval is 3 hours.

Temperature Sensor: "*Temperature_Sensor_Tab*" is the table in "PowerDB" for sensor data. It has data fields "*time_point, sensor_id, location, measure_value*". The time interval is 15 minutes.

Home Calendar: "*Home_Calendar_Tab*" is the table in "PowerDB" for home calendar data. It has data fields "*calendar_item_id, date, date_type*".

Schedule: "*Schedule_Tab*" is the table in "PowerDB" for scheduling details of electricity consumption and generation data at the residential home. It has data fields "*schedule_id, calendar_item_id, schedule_details*". The "schedule_ details" includes detailed running mode, start time, and end time for each household appliance with running time flexibility.

3.3 System Modules

The power smart home system manages the power consumption at a residential home in order to reduce the cost of household electricity consumption by considering the varying power tariff of smart grid and predictable local power generation. The proposed system will take into account of a rich set of data about smart grid, local power generation, power consumption of individual household appliances, weather conditions, measured properties by sensors, and occupants' activity plan. The power smart home system collects these data and save them in the "PowerDB" database described in last sub section. The power smart home system has the interfaces to get control commands of home occupants from appliance controllers and/or applications on computer/smart phone. The smart home system will make the schedule for local electricity generation and consumption at a residential home. The smart home system will perform event-driven dynamic rescheduling according to dynamic power supply, local generation, and operations of household appliances. The smart home system will perform real time control on solar PV, household appliances, and sensors. The development of the power smart home system follows a typical object oriented design with multiple classes shown in Figure 2.

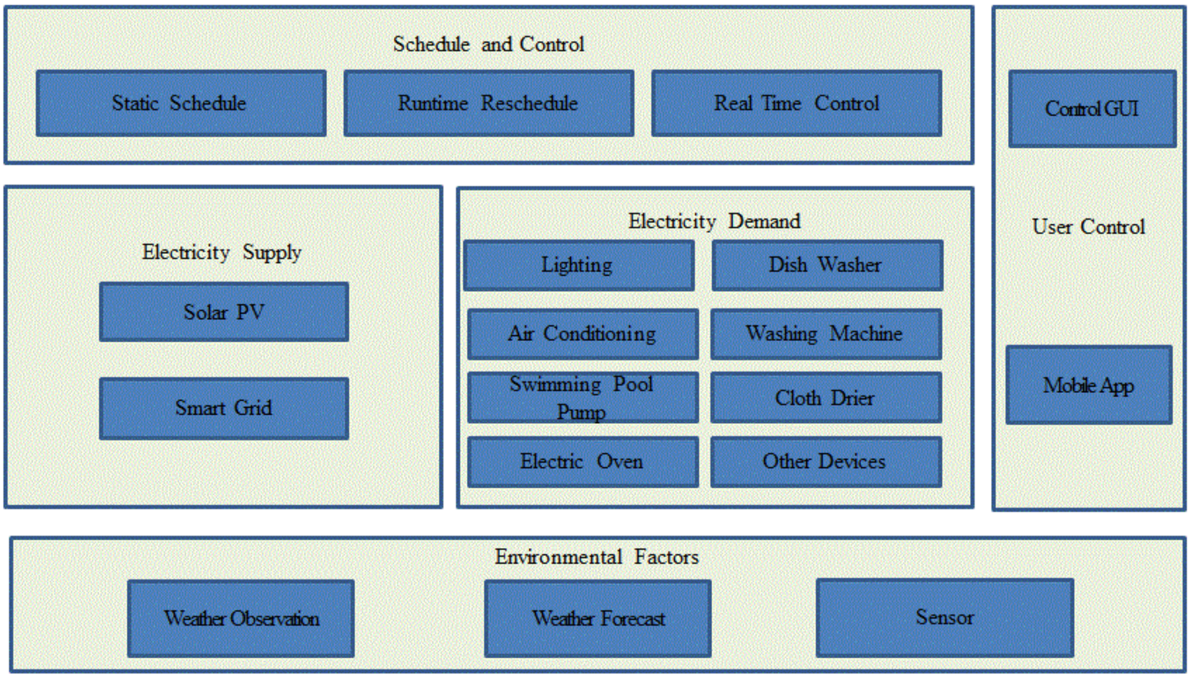

Fig. 2. System Modules of Power Smart Home System

The package "**Environmental Factors**" has classes "*Weather Observation*", "*Weather Forecast*", and "*Sensor*". The "*Weather Observation*" collects and saves local area's weather observation data of the residential home from online broadcast services of weather observation. "*Weather Forecast*" collects and saves local area's forecast weather data of the residential home from online weather forecast services. The "*Sensor*" class collects and saves temperature sensor data according. It has one method to collect data in a fixed time interval and another method to collect data at real time.

The package “**Power Supply**” has classes “*Solar PV*” and “*Smart Grid*”. The “*Solar PV*” has a method to fetch power generation data from ZigBee Panel Meter, a method to format and save data in the “*Solar_PV_Tab*” of “PowerDB” database, and a method to control the solar PV. The “*Smart Grid*” has a method to fetch smart grid data from ZigBee Panel Meter, a method to format and save data in the “*Smart_Grid_Tab*” of “PowerDB” database.

The package “**Power Demand**” has classes “*Lighting*”, “*Air Conditioning*”, “*Swimming Pool Pump*”, “*Electric Oven*”, “*Dish Washer*”, “*Washing Machine*”, “*Cloth Drier*”, and “*Other Devices*”. Each class in this package has a method to fetch power consumption data from ZigBee Panel Meter, a method to format and save data in the corresponding table of “PowerDB” database, a method to monitor the status of the appliance, and a method to set the running mode and control the appliance.

The package “**User Control**” has classes “*Control GUI*” and “*Mobile App*”. The “*Control GUI*” has a graphic user interface for the home occupants to monitor and control the smart home system. The “*Mobile App*” provides the remote access of the smart home system. The “*Mobile App*” will run on smart phones as an application. Home occupants can remotely monitor and control electricity facilities including household appliances, solar PV, smart grid, and home sensors.

The package “**Schedule and Control**” has classes “*Static Schedule*”, “*Runtime Reschedule*”, “*Real Time Control*”. The “*Static Schedule*” performs the task to make a static schedule for electricity consumption of household appliances in the context of local power resources and smart grid according to the weather forecast and occupants’ predictable activities. The “*Runtime Reschedule*” looks after the rescheduling for electricity consumption of household appliances as response of real time status of power consumption. More details of “*Static Schedule*” and “*Runtime Reschedule*” will be provided in the following two sections. The “*Real Time Control*” manages real time control requirements by calling control methods defined in classes for solar PV, household appliances, and sensors.

4 Static Scheduling and Runtime Rescheduling

This section provides the description of day-ahead static scheduling and runtime rescheduling of electricity consumption of household appliances in the context of weather forecast and occupants' activity plan.

4.1 Static Scheduling

The proposed day-ahead scheduling scheme in our previous work [7] is employed to build up the “Static Schedule” class. In the proposed static scheduling scheme, the energy models and profiles of smart grid, local power resources, and household appliances at residential homes are defined in the context of weather forecast and occupants’ activity plan. It is assumed that the smart grid has a variable electricity tariff and electricity power cannot be sold back to the smart grid when the electricity voltage of the smart grid is equal to or higher than a threshold value. The schedule of electricity consumption and local generation at a residential home has been identified as an optimization problem for minimizing the total cost of electricity power while satisfying power requirements at a residential home. A practical first-principle-based solution has been developed for making the static schedule to achieve the approximate minimum total electricity cost. The static scheduling scheme has taken into account of the dynamic relationships among local power generation, power supply of the smart grid, and consumption demand. In the “Static Schedule” class, the profiles of smart grid, local power resources, and household appliances are built up based on data stored in “PowerDB”. The profile of smart grid is generated by querying “PowerDB” tables “Smart_Grid_Tab”, “Weather_Observation_Tab”, and “Home Calendar Tab” with local weather forecast data and occupants’ activities plan. The profile of local power resources is generated by querying “PowerDB” tables “Solar_PV_Tab”, and “Weather_Observation_Tab” with local weather forecast data. The electricity consumption profile of each household appliance is generated by querying the corresponding “PowerDB” table for the appliance and “PowerDB” tables “Weather_Observation_Tab”, and “Home_Calendar_Tab” For lack of space, here we only provide the above high level description. The detailed description of static scheduling could be found in [7].

4.2 Runtime Rescheduling

The static schedule is created by optimizing the running of household appliances in one day period to minimize the total cost of electricity power. The “*Static Schedule*” class will take charge of this task. The static schedule is based on the statistical prediction of smart grid, local power generation, and consumption demands of household appliances in the context of predictable weather conditions and occupants' activities plan. In real time, weather conditions and occupants activities could have big differences from what they have been predicted to be. The operation status of the smart grid, local power generation, and household appliances could be far away from what they are in the original static schedule. It is necessary to reschedule the running of flexible household appliances. The runtime rescheduling happens in the following two cases:

- Weather conditions according to updated weather forecast are significantly different from what they are in previous weather forecast when the original schedule is made.
- Before running a household appliance with a flexible starting time, it is found that there is significant difference between the real time status of smart grid, local power generation, and electricity consumption of household appliances and what has been predicted when the original schedule is made.

The "*Runtime Reschedule*" class has one method to perform runtime rescheduling in above first case and another method to perform runtime rescheduling in above second case.

5 Related Work

The challenges, research questions of energy informatics have been discussed in [11]. The development of environmentally sustainable business practices have been highlighted in the perspective of information systems. [12] provides a survey of the common trends for renewable energy systems of wind and solar-PV and energy-storage systems of flywheels, hydrogen, compressed air, supercapacitors, superconducting magnetic, and pumped hydroelectronic. [3] presents the assessment of future costs and technical potential of renewable energy sources including wind, solar-PV, biomass, and liquid fuel from biomass. [13] discusses the surplus-electricity production problem due to fluctuations of sustainable energy resources. The flexibility in electricity management is recommended by either reducing the surplus production or moving electricity demands from high price periods to low price periods.

Smart home [1] has been coined as a concept to incorporate domestic devices that control features of the home by exploiting a broad range of enabling technologies such as smart appliances, sensor networks, smart grid, local renewable energy sources, and data communication technologies. There have been a number of projects being developed for the purpose of proof-of-concept demonstration of the smart home concept. [14] presents an overview of the smart home concept and some challenges that information and communication technology will face in the smart home environment. Related to smart home, domotics, more commonly known as “home automation”, have attracted more attentions in recent years to control entertainment, heating, broadband, lighting and security from one of many types of digital computer control devices, panels and mobile handset [15].

The authors in [16] propose a rule-based framework based on Event-Condition-Action pattern inherited from the field of expert systems for heterogeneous subsystems management in smart home environment. This work focuses on Event-Condition-Action rule mechanism without detailed description of components of a smart home system. [17] explores the relationship between human and automated intelligence and how it is manifest in green buildings. The concept of “occupant intelligence” is emphasized for providing flexible, adaptive task environments, refined control zones and technologies that maximize occupants’ access to adaptive opportunities. [18] reports a simulation system for validating contextual rules in smart homes in the context of a smart home being capable of sensing the home’s occupants and their current requirements and states, and providing optimized services to them. This work is still at its early stage and only high level results are provided.

MavHome is proposed in [19] as an agent-based smart home which allows a home to act as an intelligent agent in an adaptive and automated environment. This research is at a high abstract level without considering specific features of home appliances and/or inhabitants. [20] reports the research on semantic representation of energy-related information in future smart homes. The proposed knowledge base follows the Web Ontology Language standard. This work focuses on the representation of individual home facilities and their energy demand or supply. The dynamic relationships of facilities in smart homes are beyond it major concerns.

The smart grid is a convergence of information technology and communication technology with power system engineering by enabling utilities to make more efficient use of their existing assets through demand response, peak shaving, and service quality control [5]. In a smart grid, micro-grids will be integrated in a manner of plug-and-play through dedicated highways for data collection and power exchange. [21] overviews the approach toward a smart grid with high level description about how to make an electronic power transmission system smart, the advantages of an intelligent processor in each component, substation, and power plant, diagnostic monitoring of transmission equipment, and the electric power system as a complex adaptive system. [4] presents the approach to build smart appliances which can sense the environment. This work provides a terminology that discriminates the real-world situations, the data collected, the abstraction of data, and the application that makes use of the knowledge. [22] employs a user-centric perspective for mapping consumers' perception of the possibilities of demand side management through smart household appliances in smart grid.

On the foundation of existing academic research and industry initiatives on smart grid, smart appliances, smart homes, and renewable energy sources, we work on a smart home system approach focusing on power management at residential homes in the context of smart grid. The power smart home system aims to achieve more efficient use of energy utilities at a resident home by considering the status of smart grid, local power generation, and electricity demands of household appliances in the context of weather conditions and occupants' activities plan.

6 Concluding Remarks

The research interest of energy efficiency at residential homes is rapidly growing further with the advances of emerging technologies of smart grid, sustainable energy sources, smart appliances, electricity smart meters, and accurate monitor and prediction of environmental factors. This paper reports our early stage research on power smart home system in the context of smart grid. The system architecture has been presented with details of communication network, data storage, and system modules. The static scheduling and runtime rescheduling have been described. The proposed power smart home control and management approach has the capability to manage and coordinate household appliances and local power generation with consideration of the status of smart grid, weather forecast and observation data, activities plans and requesting commands of home occupants, real-time data from sensors. This early stage work highlights the research motivations and high level design of the proposed power smart home. The proposed architecture will provide a solid foundation for evolving power smart home system in its implementation in the reality. More details of proposed approach and the cost/benefit analysis will be provided in the future.

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