Survey Paper on Renewable Energy Integration for Smart Homes

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Abstract—Demand Side Management (DSM) will play a significant role in the future smart grid by managing loads in a smart way. DSM programs, realized via Home Energy Management (HEM) systems for smart cities, provide many benefits; consumers enjoy electricity price savings and utility operates at reduced peak demand. In this paper, Evolutionary Algorithms (EAs) (Binary Particle Swarm Optimization (BPSO), Genetic Algorithm (GA) and Cuckoo search) based DSM model for scheduling the appliances of residential users is presented. The model is simulated in Time of Use (ToU) pricing environment for three cases: (i) traditional homes, (ii) smart homes, and (iii) smart homes with Renewable Energy Sources (RES). Simulation results show that the proposed model optimally schedules the appliances resulting in electricity bill and peaks reductions.

Keywords– Appliance Scheduling, Binary Particle Swarm Optimization, Genetic Algorithm, Cuckoo Search Algorithm, Energy Management System, Electricity Pricing, Smart Grid

I.Introduction

Global energy demand is increasing rapidly in comparison to the steady growth of energy generation and transmission setups. Consequently, widening the demand and supply gap. In traditional grids, utilities cater this situation by increasing the total generation capacity as a function of peak demand. However, the resulted system (generation and distribution) by a large part is unutilized [1], [2]. Recently, two parallel approaches are developed to handle such situations: (i) using and promoting energy efficient technologies to reduce the aggregated power consumption, and (ii) developing strategies to control the aggregated power demand. Collectively, the two parallel approaches make DSM whereas the later approach is known as Demand Response (DR) [3], [4].
United States household electricity usage data show that 42% of energy is consumed by household appliances [5]. Major forces are creating a new paradigm on residential electricity markets as energy optimization becomes an increasingly important challenge in our society. New technologies are being deployed, including advanced meters, controllable appliances [6], distributed energy generation and storage systems, i.e., plug-in hybrid electric vehicle batteries, stand-alone storage systems, and communications capabilities. New laws are being proposed to allow electricity consumers to access pricing information. New dynamic pricing policies are likely to be implemented at the retail level over the next years [7], [8]. Energy management controllers [9] are primarily designed to control load within a single home. They

often take into account the utility data like load forecasts or ToU pricing for scheduling the household appliances. On the customer side, customers have the incentive to shift their electricity usage from high peak hours to low peak hours so that their electricity bills can be reduced [10], [11].

DR is defined as "changes in electricity usage by end customers from their normal consumption patterns in response to changes in the price of electricity over time". Price based DR programs consider flattening demand fluctuations as an objective. Both the customer and the utility will get benefits from DR. It encourages the customer to reduce the peak demand in response to the incentives [12]. A DR strategy coordinates the requirements between the energy provider and the customer [13]. On the utility side, by reducing high peaks, DR programs are helpful in protecting grid from the risk of outages, reduce the usage of spinning reserves during peak load periods, balance the supply demand ratio, and improve the grid reliability [14]–[16]. Further DR benefits include: (i) lower electricity price in wholesale market, (ii) adequacy saving and operational security, (iii) integrated resource planning studies, and (iv) improved choice for using DR [17], [18].

In contrast to DR programs, integration of renewable energy into residential units provides reliable, efficient and most attractive solution now a days. It can curtail electricity cost at residential premises and flatten the peaks at utility premises. The work presented in [5], [6] uses various types of battery storage systems for electricity cost reduction along with grid

II. LITERATURE SURVEY

Grid of the future Journal Paper, Article 787536 Power and Energy

This [Smart grid] transformation will be necessary to meet environmental targets, to accommodate a greater emphasis on demand response (DR), and to support plugHin hybrid electric vehicles (PHEVs) as well as distributed generation and storage capabilities On one hand, the transition to a smart grid has to be evolutionary to keep the lights on; on the other hand, the issues surrounding the smart grid are significant enough to demand major changes in power systems operating philosophy

Smart integration Journal Paper, Article 626381, Power and Energy

Smart grid, which generally includes improvements upward of the meters all the way to the transmission network and beyond Smart metering, sometimes called advanced metering infrastructure (AMI), which usually includes control and monitoring of devices and appliances inside customer premises Smart pricing including real time pricing (RTP) or, more broadly, time variable pricing, sometimes including differentiated pricing Smart devices and in home energy management systems such as programmable controllable thermostats (PCTs) capable of making
intelligent decisions based on smart prices Peak load curtailment, demand H side management (DSM), and demand response (DR) Distributed generation, which allows customers to be net buyers or sellers of electricity at different times and with different tariffs, for example, plug in hybrid electric vehicles (PHEVs), which can be charged under differentiated prices during off peak hours The main drivers of change include: o Insufficient central generation capacity planned to meet the growing demand coupled with the increasing costs of traditional supply side options o Rising price of primary

fuels including oil, natural gas, and coal o Increased concerns about global climate change associated with conventional means of power generation o Demand for higher power quality in the digital age.

A frame work for operation and control of smart grids with distributed generation, Conference Paper, Article # 5963 , Power and Energy,
The current status of distributed generation technologies and Flexible AC Transmissions (FACTS) Technologies is reviewed. Then this paper discusses a framework for operation and control of smart grids with distributed generation and FACTS in which two controls such as voltage control and stability control are included

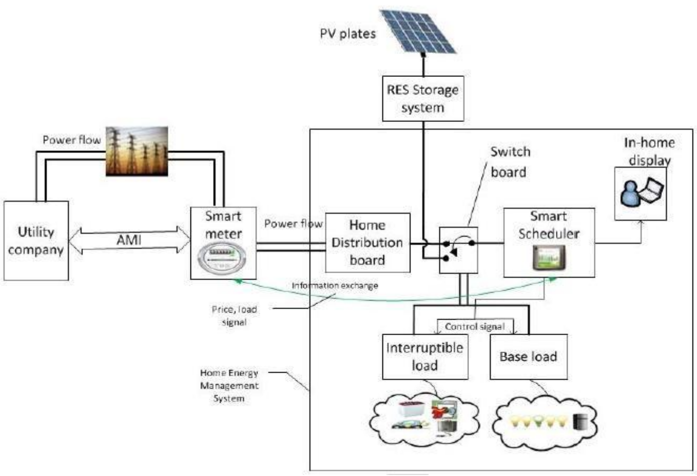
From smart grids to an energy Oriented : Assumptions, architectures and requirements, Conference Paper, Article #
523385,* \ n implementation of smart grids is an energy Internet where energy flows from suppliers to customers like data packets do in the Internet. Apparent benefits from an energy Internet are its openness, robustness and reliability. This paper uses electricity as an example to present some key assumptions and requirements for building the energy Internet. An example is presented.

III. PROPOSED SYSTEM

An optimal approach for scheduling the power usage of smart appliances in a home is proposed based on the pricing scheme. Accurate and reliable load management are a key element of the automation. Whereas, automation of appliances is a critical aspect of energy management in the residential sector, especially in the smart grid environment. The concept of load scheduling approach to monitor the electricity usage of appliances is introduced.

Transmitting and distributing direct energy supply from renewables—such as solar and wind—when and where needed in the grid is a real challenge. Through our client engagements, it is clear that the renewables integration focus is shifting to the “midgrid”—where renewable generation meets medium voltage apparatus in a new, smart distribution system.

IV. Block diagram



Hardware requirements:

- Micro controller
- Power supply unit
- Energy meter
- Relay driver
- Battery
- Short circuit sensor

Software:

- Embedded C program
- MP Lab
- PIC kit 2
- Ccs compiler
- Express pcb

V. Description .

MICROCONTROLLER:

High-Performance, Enhanced PIC Flash Microcontroller in 40-pin PDIP The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2wire I2C bus, a USART, and a Parallel Slave Port. Microchip PIC16F877A Microcontroller

Features High-Performance RISC CPU Lead-free; RoHS-compliant Operating speed: 20 MHz, 200 ns instruction cycle Operating voltage: 4.0-5.5VIndustrial temperature range (-40° to +85°C)15

Interrupt Sources35 single-word instructions All single-cycle instructions except for program branches (two cycle) Special Microcontroller Features Flash Memory: 14.3 Kbytes (8192 words)Data SRAM: 368 bytes Data EEPROM: 256 bytes Self reprogrammable under software controlIing-Circuit Serial Programming via two pins (5V) Watchdog Timer with on-chip RC oscillator Programmable code protection Power-saving Sleep mode Selectable oscillator options In Circuit Debug via two pins Peripheral

Features33 I/O pins; 5 I/O portsTimer0: 8-bit timer/counter with 8-bit prescalerTimer1: 16-bit timer/counter with prescaler Can be incremented during Sleep via external crystal/clockTimer2: 8-bit timer/counter with 8-bit period register, prescaler and post scaler

Two Capture, Compare, PWM modules16-bit Capture input; max resolution 12.5 ns16-bit Compare; max resolution 200 ns10-bit PWMSynchronous Serial Port with two modes:

POWER SUPPLY: It convert mains ac to low-voltage regulated DC power for the internal components. Power supplies is 220v

ENERGY METER: the meter which is used for measuring the energy utilizes by the electric load .The energy is the total power consumed and utilised by the load at a particular interval of time**.**

RELAY DRIVER: Relays are components that permit a low-power circuit to control signals or to switch high current ON and OFF which should be electrically isolated from controlling circuit.

SHORT CIRCUIT SENSOR: It is an electric circuit that allows a current to travel along a unintended path with no or a very low electrical impedence

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VI. CONCLUSION.

Through this method we came to conclude the efficient and appropriate power supply and reduceses the electricity bills and peak reduction .

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