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Green Charge: Managing Renewable Energy in Smart Buildings

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A B S T R A C T

The application of solar energy is more universal daily. In general, the solar power generation and solar illumination system are more popular for people. With regard to solar illumination system, which can be built while combined the charger and converter structure. It can charge the battery during the day, while lighting the LED module at night. In recent year, many charge methods have been widely used. An important way to decrease both transmission and distribution (T&D) losses and carbon emission is through distributed generation from many small on-site renewable energy sources deployed at individual building and homes. Thus distributed generation primarily relies on solar panels and wind turbines to generate electricity. A system architecture and optimization algorithm, called Green Charge, to efficiently manage the renewable energy and storage to reduce a building's electric bill. To determine when to charge and discharge the battery each day, the algorithm leverages prediction models for forecasting both future energy demand and future energy harvesting. Green Charge in simulation using a collection of real-world data sets is evaluated, and compared with an oracle that has perfect knowledge of future energy demand/harvesting and a system that only leverages a battery to lower costs. This system determines both the fraction of power to consume from the grid versus on-site battery based energy storage, as well as when and how much to charge battery based storage using grid energy.

Keywords: Grid, Green energy, Solar Panels, greenhouse gases (GHGs), Distributed Generation (DG), market-based electricity pricing models State-of-Charge (SOC),

1. Introduction

India is fast growing country in the world. In recent years the electricity demand in India is increasing rapidly because of fast growing industry. 1.4 billion Still have no access to electricity (87% of whom live in the rural areas) and 1 billion that only has access to unreliable electricity networks. Energy, as a driver of development, plays a central role in both fighting poverty and addressing climate change. The Government of India's make in India campaign will introduce more industry in India then there will be acute demand for more and more reliable power supplies. It's a very easy way to save energy and cost in your home. Energy budget system helps to control your heating, ventilation, and air conditioning systems as well as lights, blinds, and many other devices around your home with generation of energy as well. System can mean up to 30% less heating energy used and lower CO2 emissions for your home. The innovative system design not only makes it especially simple automate room conditions, but also harmoniously blends in into environmentally surroundings, even into exclusive interiors. An energy budget will lead to balance sheet which calculates your energy expenditure against energy generated means to reduce your energy bill. We propose a system architecture and optimization algorithm, called Green Charge, to efficiently manage the renewable energy and storage to reduce a building's electricity bill. To determine when to charge and discharge the battery each day, the algorithm leverages prediction models for forecasting both future energy demand and future energy harvesting. We evaluate Green Charge in simulation using a collection of real-world data sets, and compare with an oracle that has perfect knowledge of future energy demand/harvesting and a system that only leverages a battery to lower costs (without any renewables). Green Charge's savings for a typical home today are near 20%, which are greater than the savings from using only net metering. The proposed system determines both the fraction of power to consume from the grid versus on-site battery based energy storage, as well as when and how much to charge battery based storage using grid energy.

2. Literature Survey

Solar power is one of the efficiently used renewable energy in most of the smart buildings. But it has significant drawback that has prevented its widespread of adoption. The generated electricity is intermittently based on uncontrollable and changing environmental conditions. Over the last few decades, a decline in fossil fuels reserves has been observed worldwide. Alternately, fossil fuels are not being newly formed at any significant rate, and thus present stocks are ultimately finite. If the current rate of energy consumption is continued, the limited reserves of coal, oil and natural gas may last only for 122, 42 and 60 years, respectively.

Energy development is increasingly dominated by major global concerns of air pollution, fresh water pollution, coastal pollution, deforestation, biodiversity loss and global climate deterioration. To prevent disastrous global consequences, it would increasingly be impossible to engage in large-scale energy-related activities without insuring their sustainability, even for developing countries in which there is a perceived priority of energy development and use and electricity generation over their impact on the environment, society, and indeed on the energy resources themselves.

The concentration of greenhouse gases (GHGs) in the atmosphere has been increasing for a variety of reasons. CO2 in the atmosphere is increasing as a result of the burning of fossil fuels. Global warming and mitigation of GHGs is presently the major issues of international concern. The Intergovernmental Panel on Climate Change (IPCC) was set up in 1988 to study different aspects of climate change

2.1 Objectives

- The main aim of this work is to demonstrate the process of harnessing renewable energy efficiently and making proper use of it.
- To measure energy generated from renewable energy sources is demonstrated through the use of microcontroller.
- To develop an alternative approach that combines market-based electricity pricing models with on-site renewable and modest energy storage (in the form of batteries) to incentivize DG (Distributed Generation).
- To determine when to charge and discharge the battery each day, the algorithm leverages prediction models for forecasting both future energy demand and future energy harvesting

3. Proposed System Architecture

In this proposed work arduino microcontroller is the brain of the system, in this system there are two ways to charge the battery one is from solar panel and another one is from power supply, when the power is obtained from the solar panel the relay will switch to solar panel input and charge the battery using charge controller, when the power supply is not obtained from the solar panel the relay will switch to the power supply and the battery will charge using the main power supply by using charge controller.

In the other hand of this proposed model the light is controlled using LDR and IR sensor, the IR sensor will sense is the person is present in the room or not, if the person is present the it will increase the count and display the count value in the LCD display and checks for LDR sensor value if the room is dark it will turn on the LED light which is connected relay and it will display that light is turned on in the LCD display and if the room is bright it will not turn on the light but it will increase the count value, and it will display that light is turned off in the LCD display, if the person exit's the room the count value is will reduced by one and it will be displayed on the LCD display, if the count is zero then LED light will not turn off.

And the lights can also be controlled using a bluetooth app. Many embedded systems have substantially different designs according to their functions and utilities. In this project design, structured modular design concept is adopted and the system is mainly composed of a single microcontroller, solar panel, boost circuit, battery and voltage divider. The microcontroller placed in the system forms the control unit of the project. Embedded within the microcontroller is a program that helps the microcontroller to take action based on the inputs provided by voltage divider. Voltage generated from Solar Panel form the renewable energy in this demonstration. The output of the Solar panel is fed to the boost circuit and another to voltage divider circuit. The input voltage fed to the voltage divider is divided by a factor and this voltage forms the output voltage which is given to the ADC unit of the microcontroller. The battery voltage is also given to another voltage divider whose output is fed to the ADC unit of the microcontroller. The output voltage of Solar panel and battery are compared by the microcontroller. If the solar panel is generating less voltage and the voltage stored in battery is less, microcontroller charges the battery through A.C mains.

To demonstrate the working of load, a high power LED is connected to the microcontroller via an LED driver. To turn ON the LED, power from the battery is utilized. LCD is used to display the working of every unit. Government rule for every building to install solar panels as per their building electricity load limit. 50% of the basic load has to consume solar panels generated renewable energy. This project involves, 10W solar panel, 2 nos 12V 1.3AH Lead Acid Battery and DC loads (LED, cpu fans etc). To demonstrate the model, assume 3 level of cutoff. In Day time solar will charge the battery and Paid Electricity is not used. Once the battery voltage reduces below 2nd cut off, then the battery is charged through paid electricity. Once the battery charge increases this 1st cut off, then again the paid electricity will stop charging the battery. This process will continue through the day time. In Night time solar energy will be zero. Now the unit will work smarter. Night 11pm will be considered as the sleep time and power consumption will be very less. Till battery voltage reduces to 2nd cut off, paid electricity wont charge the battery. Assume, now 8pm and the battery voltage is reduced 2nd cutoff. Now the paid electricity will charge the battery till it reaches 1st cut off. This process will continue till night 10pm. After 10pm, our unit won't charge the battery till it reduces to 3rd cut off. Because now already it is 10pm and after 11pm power will be used very less. And again by morning solar gets active to charge the battery. Our unit is showing the artificial intelligence. Complete project will be demonstrated with 2-3 different conditions.

The pulse from the maximum power point tracking system and the DC voltage from the solar system is given to the buck boost convertor. The Buck boost converter is a type of DC to DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. The duty cycle and the voltage from the solar system is given to the buck boost converter is shown by the subsystem. The two operating states of a buck–boost converter: When the switch is turned on, the input voltage source supplies current to the inductor, and the capacitor supplies current to the resistor (output load).When the switch is opened, the inductor supplies current to the load via the diode D. In order to improve the life time of the battery the logic controller is being used. The battery's state of charge (SOC), voltage and current is frequently measured. This SOC of the battery and the initialized SOC

is then given to the logic controller using a summer. The logic controller automatically controls the voltage and current when the battery reaches the SOC of 80% so that the charge of the battery will extend to a certain level than the ordinary charging life time of the battery.

4. Advantage, disadvantages and Applications

Advantages

• Solar energy is used which is freely available

• Due voltage regulation by buck boost constant supply voltage is obtained

• Solar Panel is low cost

Disadvantage

• Current ratings will be lower in Solar Panel

• Variations in back emf might occur in Motor

Application

• Solar Energy is used in vehicles

• Solar energy is used in street lights

• Solar energy is used in traffic lights

• Motor is also used as power source for charging batteries in vehicles ➢ Motor is used in industries, companies, etc

5. Conclusion

In this method, one can examine how to lower electricity bills using Green Charge by storing low cost energy for use during high cost periods. Analyzing the green charge costs, the expected rise in electricity prices and decrease in solar panel prices may make Green Charge return on investment and explore how to lower electric bills using Green Charge by storing low-cost energy for use during high cost periods. The typical savings today are near 20% per home with the potential for significant grid peak reduction (20% with our data). Recent battery advancements combined with an expected rise in electricity prices and decrease in solar panel prices may make Green Charge's return on investment positive for the average home within the next few years. Both, RES and micro grids are tend to be solutions for improving existing grids in a future. A hardware model is implemented for switching on and off for two loads and it can also increase the number of loads as per our requirements. During the normal power supply also the model can be switch on and off using the remote control. The main advantage of this system is continuity of power supply without any breaks along with remote control of devices. The initial cost as well as maintenance cost of the system is very less. So it can be easily implemented for any domestic loads.

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