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IoT based Dynamic Distributed Energy Management System

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Abstract

Ubiquitous computing is foreseen to play an important role for data production and network connectivity in the coming decades. The Internet of Things (IoT) research which has the capability to encapsulate identification potential and sensing capabilities, strives toward the objective of developing seamless, interoperable, and securely integrated systems which can be achieved by connecting the Internet with computing devices. Energy growth is directly linked to well-being and prosperity across the globe. Meeting the growing demand for energy in a safe and environmentally responsible manner is a key challenge. Increasing cost and demand of energy has led many organizations to find smart ways for monitoring, controlling and saving energy. A smart energy management system can contribute towards cutting the costs while still meeting energy demand. This paper aims to establish an effective IoT based dynamic distributed energy management system. In this paper, we propose an effective energy management system with two sources. This system is having a switching network solar, the main source and the ac power line. As the intensity of solar reduces, it will automatically switches to the other source. And the excess power will be distributed to the public lighting system. These smart IoT devices allow for the usage energy data from each unit to be collected and stored in a Cloud-based database that can be analyzed and reported for energy conservation and analysis.
Keyword- IoT, Dynamic Distributed Energy, Data Production, Network Connectivity

I. INTRODUCTION

In our daily lives it is very important to save the energy resources, among them electricity has the highest prior. It is necessary for everyone to be energy conscious and make every effort to conserve our electricity. But the existing system does not provide efficient ways of monitoring and controlling the energy usage. Nowadays, the electric power system is facing a radical transformation in worldwide with the decarbonizes electricity supply to replace aging assets and control the natural resources with new information and communication technologies. The energy management system is an essential to provide easy integration and reliable service to the consumers. This system is a self-sufficient electricity network system based on digital automation technology for monitoring, control, and analysis within the supply chain. This system can find the solution to the problems very quickly in an existed system that can reduce the workforce and it will targets sustainable, reliable, safe and quality electricity to all consumers.

The smart grid technology offers the vision of enhancing the efficiency of electricity utilization from the generation, transmission, and distribution to the end-user points, together with effectively accommodating all generation and storage options and enabling consumer participation in the demand side. Meanwhile, an effective HEMS is expected to be highly automated, intelligent, interactive, and be able to support high level information communication technology (ICT) for information perception, aggregation, interaction and visualization. The Internet of Things (IoT) technology has recently acquired considerable attentions in the smart grid and HEMS researches. It is a network consists of objects having identities, virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate with the users, social, and environmental contexts. The ability of IoT to demonstrate the ubiquitous perception and the real time interactive view in the smart grid and HEMS allows the smart households and utility to monitor the usage of electricity in real-time. Based on these energy and power related information, the utility could deploy the appropriate demand side actions to the households to lower their electricity bills.

With the PV module installed, the residents could further reduce the electricity bills by directly supplying the solar power harvested to the household loads instead of buying electricity from utility during the peak price periods. While there is generally a mismatch between the actual peak hour of solar power generation and the peak demand hours of residential loads, these excessive generated solar energy can be stored in the battery-based ESS for later use or sold back to the utility for extra incomes.

II. EXISTING SYSTEM

The traditional power grid is basically the interconnection of various power systems elements such as synchronous machines, power transformers, transmission lines, transmission substations, distribution lines, distribution substations, and different types of loads. They are located far from the power consumption area and electric power is transmitted through long transmission lines. The traditional system is much less integrated than the transmission energy management system.

The smart grid is a modern form of the traditional power grid which provides more secure and dependable electrical service. It is, in fact, a two-way communication between the utility and the electricity consumer. It is capable to monitor activities of the grid-connected system, consumer preferences of using electricity, and provides real-time information of all the events. Operational challenges arise from the significantly increased complexity of modern distribution systems, especially from distributed renewable resources, electric vehicles, and demand-side management. A fully integrated and intelligent distributed energy management system is a key to meet these challenges.

III. SYSTEM ARCHITECTURE

The basic system architecture of the power system is shown in Figure 1. The smart grid evolves on the concept of two way communication between the power sources. In this system primary source considered as solar and secondary source as transmission line and there involves the power transfer between the sources. When the intensity of power from solar source decreases, the source automatically switches from solar to transmission line. The main controller used is Arduino UNO where the central controlling occurs. To the controller a LCD display is connected which displays the meter reading, excess power reading, voltage reading etc. The IoT module used is ESP8266 whose main function is the enabling of emergency shutdown during catastrophic situations. IoT modules also facilitate the device controlling in domestic environment whether the user is away or present. The system provides an efficient way of energy management by rebounding the excess energy back to the transmission line.

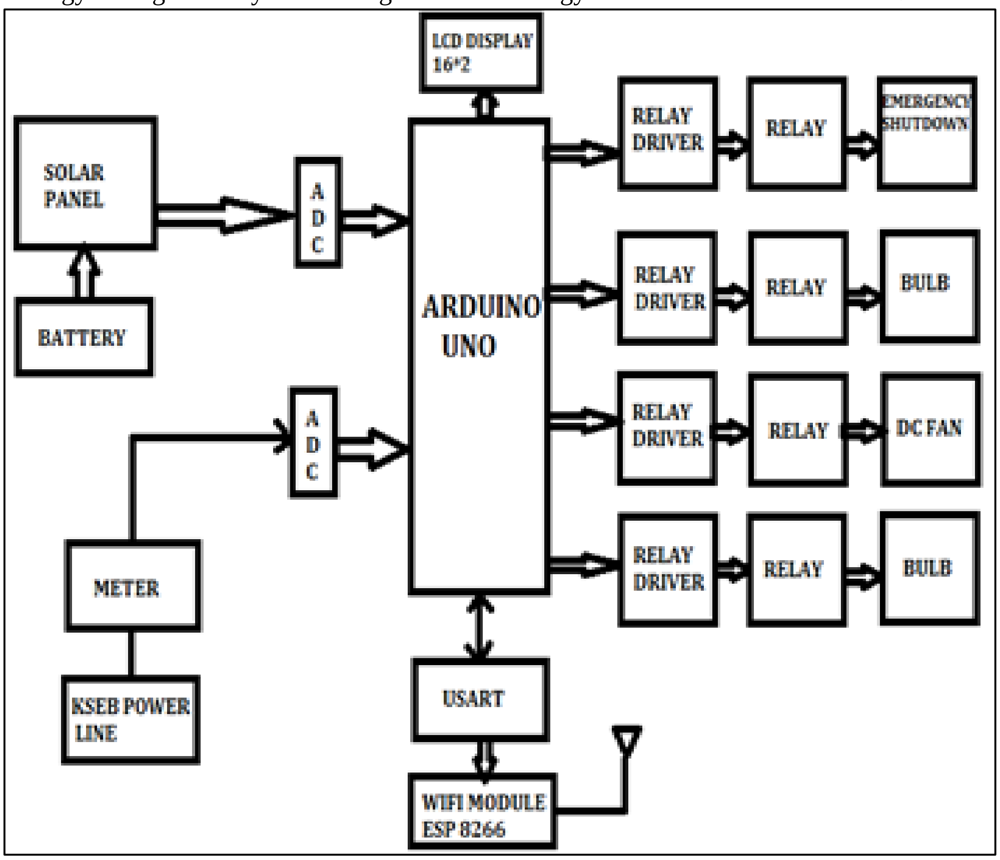


Fig. 1: Proposed System Architecture

IV. IOT IMPLANTATION

This system presents Energy Management System scheme that is embedded with Internet of Things platform. The basic idea is to collect the information of power system right from the sources and devices to the end user.

In the proposed scheme the devices in system are equipped with the sensor and actuator. The sensor and actuator are the part of network which are connected to the device which continuously collect the information and transfer the data through communication protocol using loT Platform. IP address of the board is access in order that the gateway required to know the network name and the IP address of the message dispatcher. Sensors send messages to the loT server over a link through the gateway with the configured IP. The loT server converts information from nodes, into a standard to be transmitted. Hence, data can be easily collected, represented, manipulated and aggregated wireless. It allows users to access real time data.

V. HARDWARE AND SIMULATION

A. Hardware

In this energy management system hardware components used are Arduino UNO, WiFi module, relay module, temperature sensor, Light depend resistor(LDR), Liquid crystal display (LCD),12v battery, energy meter and solar panel

1) Arduino UNO

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.

2) Wi-Fi Module

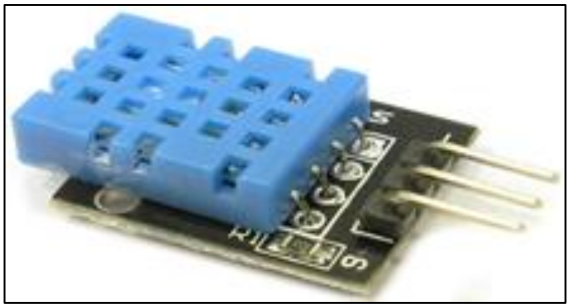
In this system we are using ESP8266. It can work both as a Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things(IoT) as easy as possible. It can also fetch data from internet using API's hence your project could access any information that is available in the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user friendly.

3) Relay Module

A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5 V provided by the Arduino pins.

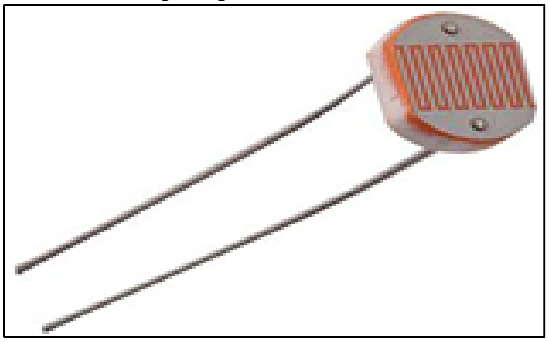
4) Temperature Sensor

Temperature sensor used is DHT11. It is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin. It's fairly simple to use, but requires careful timing to grab data.



5) Light Depend Resistor

A photoresistor or light dependent resistor is a component that is sensitive to light. When light falls upon it then the resistance changes. Values of the resistance of the LDR may change over many orders of magnitude the value of the resistance falling as the level of light increases. It is not uncommon for the values of resistance of an LDR or photoresistor to be several mega ohms in darkness and then to fall to a few hundred ohms in bright light.



6) Liquid Crystal Display

Liquid crystal display screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines.

7) Battery

A 12-volt, 1 amp-hour battery store 12Wh, but the voltage is usually a critical parameter for a battery, and once a voltage is selected, the capacity can be specified by the amp-hour rating.

8) Energy Meter

Energy Meter is an electrical instrument that measures the amount of electrical energy used by the consumers. Utilities are one of the electrical departments, which install these instruments at every place like homes, industries, and organizations, commercial buildings to charge for the electricity consumption by loads such as lights, fans, refrigerator, and other home appliances.

9) Solar Panel

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells must be connected electrically in series, one to another.

B. Simulation

We have simulated the interfacing of temperature sensor, LDR, LCD, relay, battery and Wi-Fi module with Arduino UNO. The software codes were developed and simulated by using Arduino IDE Platform. The interfacing of relay with temperature sensor, LDR and battery were simulated according to certain conditions that it works whenever the temperature is above 30°C the corresponding relay gets ON. In LDR whenever the light intensity decreases the corresponding relay gets ON. In the case of battery, when there is voltage fluctuation that is below 10v the relay gets ON. The software codes were developed according to these conditions and experimented the system.

VI. RESULT

We address a new smart home control system based on sensor networks to make home networks more intelligent and automatic. We implement the proposed system and develop related hardware and software. The temperature sensor, LDR and battery is connected to relay in such a way that it works according to the conditions given. For temperature sensor whenever the temperature is above 30°C the corresponding relay gets ON. In LDR whenever the light intensity decreases the corresponding relay gets ON. In the case of battery, when there is voltage fluctuation that is below 10v the relay gets ON. All the values measured from these sensors are displayed on to the LCD screen. The data from sensors are accessed through the WiFi module. The values measured are displayed in a webpage and by giving request the current status value of sensors can be seen.

VII. CONCLUSION

In the customary grid, the capability for monitoring and controlling power flow in real time is restricted to high voltage and high current transmission and reception. They are automated so that is not only efficient but also it ensures safety of human beings. In this paper, we have presented the complete implantation of loT architecture, an implementation and an experimental demonstration on domestic load prototype of Grid on the loT platform. We have we have continuously access the load parameter through loT architecture and being able to monitor the system remotely. We suggest new ubiquitous home scenarios based on the proposed system. You save money not only on the installation and usage costs, but many governments are providing tax incentives to encourage "green home" buildings. In short, these systems save money and make good sense. Furthermore, we also expect to enlarge more types of sensor that is required and useful at smart home applications to establish entire power consumption database of sensor models so that it can facilitate processing efficiency of home sensor network.

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