

## International Journal of Innovative Research in Science, Engineering and Technology

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# IOT based Smart Grid to Remotely Monitor and Control Renewable Energy Sources using VLSI

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**ABSTRACT:** The quest for sustainable energy models is the main factor driving research on smart grid technology. Smart Grids represent the bridging paradigm to enable highly efficient energy production, transport, and consumption along the whole chain, from the source to the user. This paper describes a Smart Grid architecture implemented with the help of Web of Things. The goal of the Smart Grid architecture using Web of Things (WOT) is to provide the reliable power supplies to the consumers by making maximum use of solar energy source. The Web of Things comprise of a set of Web services provide on top of a number of Internet enabled Embedded devices. The Web browser on any computer can act as an interface to the services provided by this Web of Things. Web of Things is a new information processing and acquisition method, that is been widely used in intelligent transportation, environmental monitoring and other fields. The WOT is an important technical mean to the development of smart grid and security smart grid. WOT technology can effectively combine the infrastructure resources in increase the level of power system information, and improve the utilization efficiency of infrastructures in the existing power system.

**KEYWORDS:** Web of Things (WOT), Smart Grid (SG), Solar Energy Source, FPGA, Smart Home (SH), ADC

## I. INTRODUCTION

The Smart grid is a technology that makes electric grid control, automate and manage the growing demands and needs of electricity, allowing two-way communication between the utility and the customers. Smart grid improves power quality, provides efficient transmission, quicker rerouting when equipment fails or when outages occur and reduces peak demand. An essential feature of a smart grid is to improve the efficiency, economics, and sustainability of the generation, transmission, and distribution of electricity by the use of information and communications technology. The smart grid, being a vast system, utilizes various communications and networking technologies with its applications, which include both wired and wireless communications. “Web of Things” refers to the general idea of things, especially everyday objects, which are readable, recognizable, locatable, addressable, and/or controllable via the Internet, irrespective of the communication means (whether via RFID, wireless LAN, wide- area networks, or other means).

Every day we encounter objects include not only the electronic devices but the products of higher technological development such as vehicles and equipment but things that we do not ordinarily think of as electronic at all - such as food and clothing.[1]The “things” of the real world shall integrate into the virtual world, enabling anytime, anywhere connectivity. The number of everyday physical objects and devices connected to the Internet was around 12.5 billion in 2010. The number of value expected to double to 25 billion in 2015 as the number of more smart devices per person increases, as far as to a further 50 billion by 2020. The impact and value that IOT brings to our daily lives become more prevalent as Smart devices connected in the IOT landscape..

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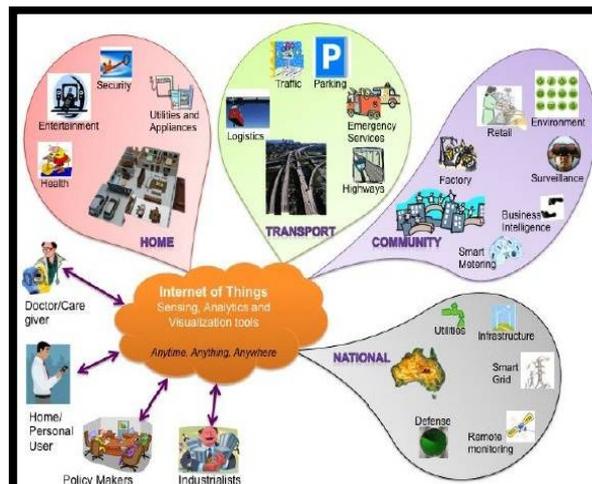


Fig 1: WOT Anything, Anywhere, Anytime

## 1. Smart Grid and Internet of Things

Smart grid is a new and modern power grid, which is highly integrated with advanced sensor measurement technology, information and communication technology, analysis of the decision-making technology, automatic control technology, and energy power technology and grid infrastructures. Compared with the traditional grid, smart grid has been improved distinctly in the optimization of power control, the flexibility of grid structure, optimizing the allocation of resources, and improving the power quality of services. Therefore, smart grid has many characteristics including strong, self-healing, compatibility, economy, integration and optimization and so forth [2]. Internet of Things, namely “the Internet in which the things connected to each other”, is the extension and expansion of Internet-based network. According to the agreed protocols, with IOT key technologies: radio frequency identification technology, sensor technology, smart technology and nanotechnology, the communication information can be exchanged, and the intelligent recognition, positioning, tracking, monitoring and management can be achieved

## II.LITERATURE SURVEY

The smart grid [1] can be considered as a modern electric power grid infrastructure for enhanced efficiency and reliability through automated control, high power converters, modern communications infrastructure, sensing and metering technologies, and modern energy management techniques based on the optimization of demand, energy and network availability, and so on. While current power systems are based on a solid information and communication infrastructure [2]. Application of wireless technologies in the smart home is dealt with by pointing out advantages and limitations of available approaches for the solution of heterogeneous and coexisting problems related to the distributed monitoring of the home and the inhabitants. Some hot challenges facing the exploitation of non-invasive wireless devices for user behaviour monitoring are then addressed and the application fields of smart power management and elderly people monitoring are chosen as representative cases where the estimation of user activities improves the potential of location-aware services in the smart home. This paper proposes a digital system for condition monitoring [3].

The system is based on hybrid network architecture (HNA), consisting of a wired infrastructure, a wireless sensor network (WSN), a power line communications (PLC) and a controller area network (CAN). The system is based on three hardware topologies: remote data acquisition units (RDAUs), intelligent sensors modules (ISMs) and a PLC modem. The growing share [4] of fluctuating power generation by renewable resources and the increasing distribution of battery electric vehicles require the integration of intelligent Energy Management Systems (EMS) into the electrical power grid. Smart Homes will be equipped with controllable consumers, suppliers and storages to realize a flexible consumption and supply of thermal and electrical energy. Smart Home automation is pushing [5] into the consumer

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market for several years, while at the same time energy companies are working on the deployment of Smart Grids. Although, a key idea of the energy transition is to integrate small energy devices at the consumer's site, the potential benefits of Smart Home technologies for Smart Grids remain unused at large until now.

### III. PROPOSED SYSTEM

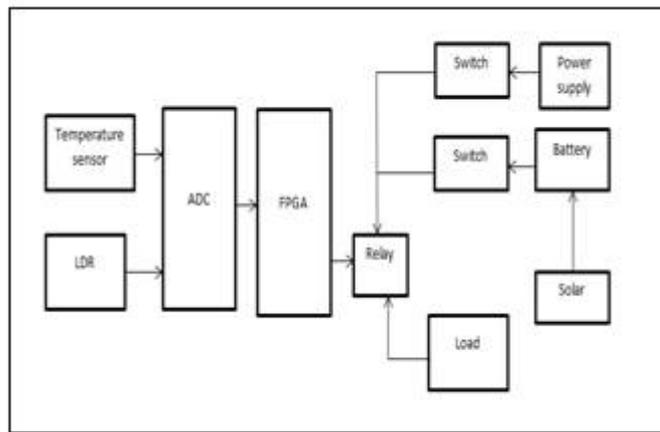


Fig 2: Block diagram of system

The fig 3 shows the proposed system of smart grid in this temperature sensor sense the temperature and LDR is applied to the Analog to Digital converter, which convert the input to digital ones. Battery is charged by solar. The supply is given to the first switch and battery is connected to another switch. Relay is ON and OFF through relay. The load is connected to relay.

### 3.1 Hardware Description

#### 1. Power supply

The basic step in the designing of any system is to design the power supply required for that system. The steps involved in the designing of the power supply are as follows: 1) Determine the total current that the system sinks from the supply. 2) Determine the voltage rating required for the different components.

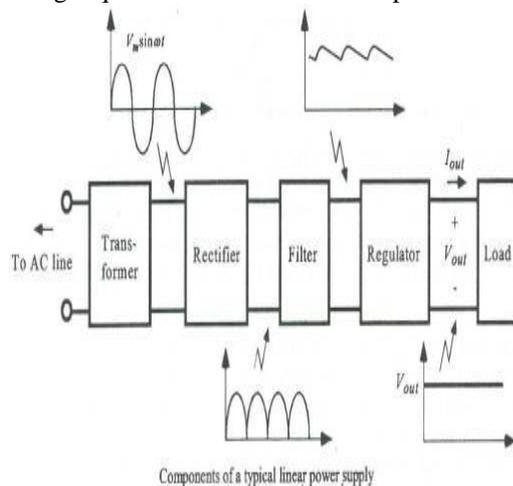


Fig 3: Power supply

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## 2. Spartan-6 FPGA

Spartan®-6 LX and LXT FPGAs are available in various speed grades, with -3 having the highest performance. The DC and AC electrical parameters of the Automotive XA Spartan-6 FPGAs and Defense-grade Spartan-6Q FPGAs devices are equivalent to the commercial specifications except where noted. The timing characteristics of the commercial (XC) -2 speed grade industrial device are the same as for a -2 speed grade commercial device. The -2Q and -3Q speed grades are exclusively for the expanded (Q) temperature range. The timing characteristics are equivalent to those shown for the -2 and -3 speed grades for the Automotive and Defense-grade devices. Spartan-6 FPGA DC and AC characteristics are specified for commercial (C), industrial (I), and expanded (Q) temperature ranges. Only selected speed grades and/or devices might be available in the industrial or expanded temperature ranges for Automotive and Defense-grade devices.

- JTAG configuration mode
- Master Serial/SPI configuration mode (x1, x2, and x4)
- Slave Serial configuration mode
- Master Select MAP/BPI configuration mode (x8 and x16)
- Slave Select MAP configuration mode (x8 and x16)

## 3. ADC

The Microchip Technology Inc. MCP3204/3208 devices are successive approximation 12-bit Analog-to-Digital (A/D) Converters with on-board sample and hold circuitry. The MCP3204 is programmable to provide two pseudo-differential input pairs or four single-ended inputs. The MCP3208 is programmable to provide four pseudo-differential input pairs or eight single-ended inputs. Differential Nonlinearity (DNL) is specified at  $\pm 1$  LSB, while Integral Nonlinearity (INL) is offered in  $\pm 1$  LSB (MCP3204/3208-B) and  $\pm 2$  LSB (MCP3204/3208-C) versions. Communication with the devices is accomplished using a simple serial interface compatible with the SPI protocol. The devices are capable of conversion rates of up packages.

### Feature

12-bit resolution

- $\pm 1$  LSB max DNL
- 4 (MCP3204) or 8 (MCP3208) input channels
- On-chip sample and hold

## 4. Cube relay

These are high quality Single Pole - Double Throw (SPDT) sealed 12V Sugar Cube relays. Use them to switch high voltage (240AC), and/or high current devices (7A). This relay's coil is rated up to 14V, with a minimum switching voltage of 10V. The contacts are rated up to 7A @250VAC and 7A @24VDC. A Relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays.

### Features:

- 12V DC SPDT Relay
- Rated up to 7A @240VAC
- Fully Sealed

## 5. Solar panel

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. A photovoltaic (PV) module is a packaged; connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 watts.

### Specification

- Output Load: 100W

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Load back up time: 10Hr.  
Input Voltage (Battery): 12V

- To find Battery Specification:  
Battery Backup: Output Load\*Load Backup  
 $B.B=100*10=1000$   
Current= $B.B/Input=1000/12=83A$   
i.e. Battery=12V, 83A.
- To Calculate Solar Plate design:  
Current of System=83A  
Battery to be charged in Hour: 7Hrs
- To find Current of Solar Plate: $83/7=12A$   
Power=Current\*Voltage  
 $P=12*12=144$   
i.e. Solar Specification: 144W,12A,12V

## 6. LM 35

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermostat. It also possesses low self-heating and does not cause more than 0.1°C temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature, i.e., its scale factor is 0.01V/°C.

Features

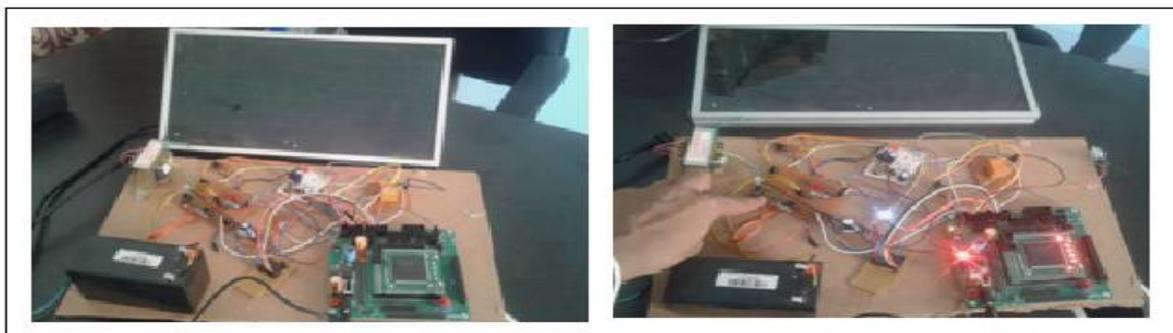
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full -55° to +150°C range

## 7. Light Dependent Resistor

LDR or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it. A photo resistor (or light-dependent resistor, LDR, or photocell) is a light-controlled variable resistor.

## IV.RESULT

### 4. 1 Hardware Module



(a) (b)  
Fig 4: Hardware implementation (a) ON condition (b) OFF condition

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## 4.2 Web Page Design

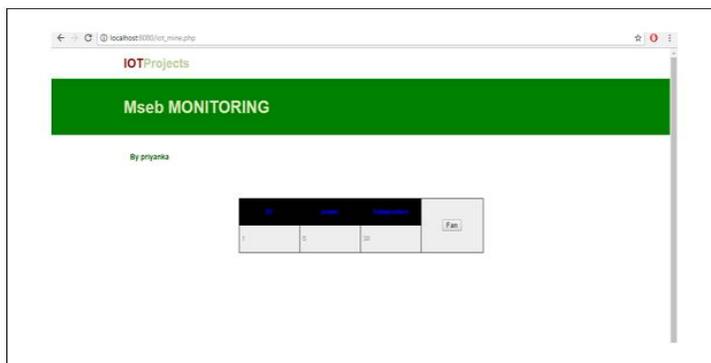
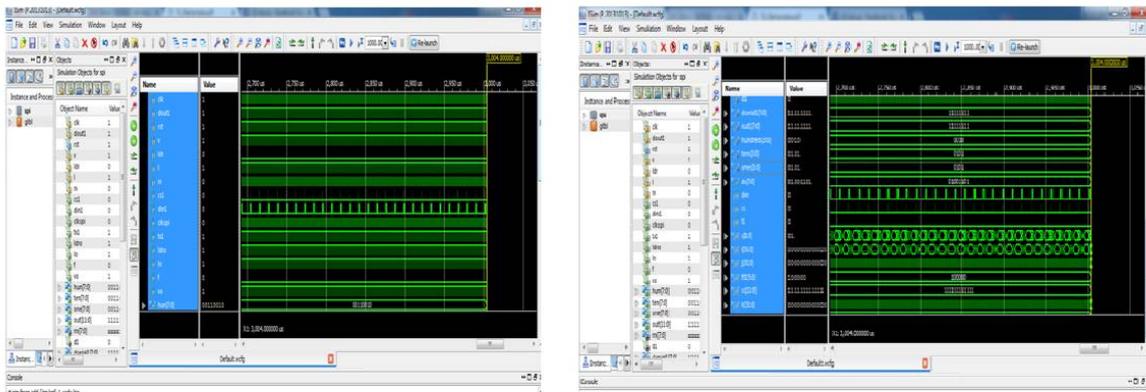


Fig 5: Web Page of System

## 4.3 Simulation Result



(a)

(b)

Fig 6: System Simulation 1 & 2

## V.CONCLUSION

The designed system is easy to implement and very customizable according to needs. It provides effective techniques of using our renewable energy resources which would otherwise have been underutilized. FPGAs have emerged as a technology that strikes an optimal balance between processing power, energy requirements, and flexibility. In this paper, an implementation of remote monitoring system for smart grids using FPGA based wireless sensor network technology has been implemented. A prototype for wireless sensing module with FPGA coprocessors was designed and implemented for monitoring line parameters. The sensor node is programmable using low power FPGA and a microcontroller. The experimentation results show that the measured parameter matches the rated parameters in the smart grid hardware prototype.

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