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An Implementation of Fpga Based Smart Meter For Home Energy Management

K. Banumathi M.Tech. Asst. Prof. A. Thameem Ansari R. Thinesh Kumar L. Vignesh
Department of ECE
Panimalar Institute of Technology
Chennai, India
vickyvignesh1406@gmail.com

Abstract **- Home Energy Management (HEM) for Smart Grid focuses on the power management on consumer side, where home appliances can be monitored and controlled to balance and optimize the power supply and consumption. Among various applications of Smart Grid technologies, Home Energy Management is probably the most important one to be addressed. HEM basically consists of smart meters, smart appliances and advanced control systems. The fundamental task of the HEM system is improving energy efficiency, data measurement, and transmission. The real-time consumption data gathered from each appliance of home are measured and transferred to a data concentrator and back to the utility and view of power consumption data and electricity pricing can be enabled in smart meter. Smart meter initiatives seek to enable energy providers and consumers to intelligently manage their energy needs through real time monitoring, analysis, andcontrol. In this paper the new architecture of FPGA implementation of Home Energy Management for Smart Grid is developed. It estimates the energy consumption of appliances by measuring the voltage, current drawn by the appliances. The other function such as price predictor, communication to the consumer can also be performed in this architecture.**

Keywords- **Home Energy Management (HEM), Smart Grid (SG), Field Programmable Gate Array (FPGA), Analog to Digital Converter (ADC), Smart meter.**

I. INTRODUCTION

The electricity delivery systems of most countries were built almost 100 years ago, where electricity travels hundreds of thousands of kilometers from central power plants to consumers with major energy losses. The structure of the current power grid is not well suited to meet the future energy demand. Hence, the SG has become one of the most important items on the agenda of many governments and utilities, since it is the key to increasing the recognition of the current problems and meets the electricity demand.

These applications, the standard are optimized for low data rate, low power consumption, security and reliability. Traditional power grids are being transformed into Smart Grids (SG) using advanced information control and communication technologies to offer higher reliability, security and efficiency in power systems. Smart Grid consists of smart meter for Home Energy Management via energy efficient communication technology.

To support both dynamic pricing and a two-way flow of electricity between homes (or micro grids) and smart meters are being widely deployed. In Compared to conventional analog meters, smart meters measure power consumption at a much finer granularity. Currently, the electricity meters are installed on consumer's premises and the consumption information is collected by meter-readers on their fortnightly or monthly visits to the premises. Meters in the past, and today in a few countries are electromechanical devices with poor accuracy and lack of configurability. Theft detection is also a challenge. This method of billing is also not suitable for the electricity supply company because it gives inaccurate account of the overall electricity consumption in Manuscript received Recent developments in this direction seem to provide opportunities in implementing energy efficient metering technologies that are more precise accurate and error free.

II. EXISTING TECHNIQUES

Currently, the electricity meters are installed on consumer's premises and the consumption information is collected by meter-readers on their fortnightly or monthly visits to the premises. Meters in the past, and today in a few countries are electromechanical devices with poor accuracy and lack of configurability.The existing technology by developing efficient home energy management using smart meter architecture. In this method to design energy efficiency, and low complexity of smart meter for home energy management using smart grid communication based FPGA. The new architecture

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of FPGA implementation of smart meter is one method reading and processing consumed energy data of each home appliance automatically with computer and communication and also gives the accurate account of the overall electricity consumption through main wireless communication protocol, ZIGBEE is chosen as lower layer communication protocol.

III.PROPOSED TECHNIQUES

The advantage of proposed Home Energy Management provides the accurate account of overall electricity consumption to the consumer side. It provides the power demand required by the consumer to the Smart Grid. Figure 1 shows a block diagram of Home Energy Management system using smart grid communication implemented in the FPGA architecture.

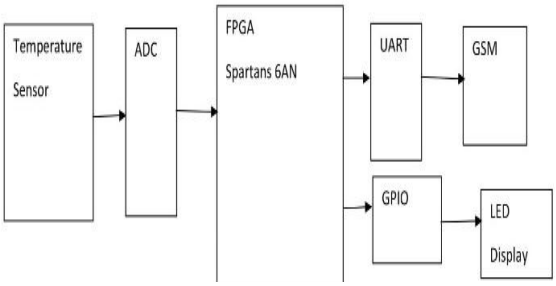

Fig.1 Block Diagram.

1. Passive Infrared Sensor (PIR)-A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion Detectors. Usage of circuitry and time saving nature. In addition itis having adjustable sensitivity and output LED indicator.All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is invisible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.

The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion Detectors. Usage of circuitry and time saving nature. In addition it is having adjustable sensitivity and output LED indicator. All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is invisible to the human eye because it radiates at in frared wave lengths, but it can be detected by electronic devices designed for such a purpose. The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection. A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion Detectors. Usage of circuitry and time saving nature. In addition it is having adjustable sensitivity and output LED indicator.

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The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion Detectors. Usage of circuitry and time saving nature. In addition it is having adjustable sensitivity and output LED indicator. The PIR sensor range is up to 10 meters at an angle of +15o or -15o.

2. PIR Sensor's working-The PIR sensors are more complicated than the other sensors as they consists of two slots. These slots are made of a special material which is sensitive to IR. The Fresnel lens is used to see that the two slots of the PIR can see out past some distance. When the sensor is inactive, then the two slots sense the same amount of IR. The ambient amount radiates from the outdoors, walls or room, etc.

When a human body or any animal passes by, then it intercepts the first slot of the PIR sensor. This causes a positive differential change between the two bisects. When a human body leaves the sensing area, the sensor generates a negative differential change between the two bisects. The infrared sensor itself is housed in a hermetically sealed metal to improve humidity/temperature/noise/immunity. There is a window which is made of typically coated silicon material to protect the sensing element.

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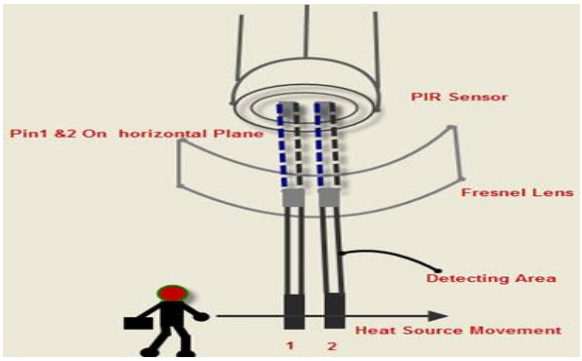

Fig. 2 Overview.

Thus, an overview of PIR sensor basics and its applications has been discussed. These sensors are used in many applications such as in real-time monitoring including physical health, electronic security systems, etc. Apart from this, for any help regarding this topic or sensor based project ideas, you can contact us by commenting in the comment section below.

IV. IMPLEMENTATION

To build an embedded system on Xilinx FPGAs, the embedded development kit (EDK) is used to complete the reconfigurable design. Figure 1 shows the design flow. Central FPGA Controller FPGA is programmable digital logic chip. The FPGA controller has multiple inputs/outputs ports, so, many components can be integrated into it. The advantages of FPGA controller are its high speed operation, and internal RAM. Altera's DE2 board and Xilinx Spartan 6 board are one of the most widely used FPGA board for development of FPGA design and implementation.

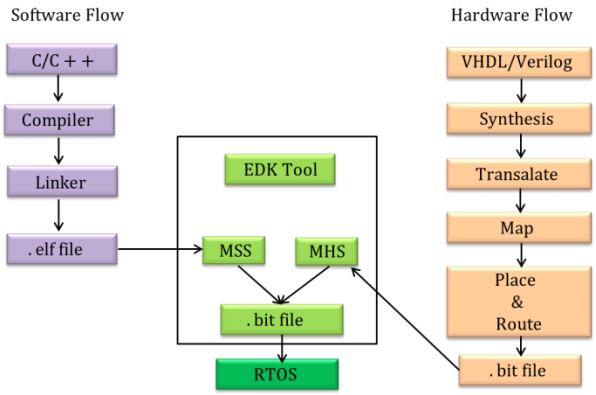

Fig.3 Design flow.

Unlike the design flow in the traditional software design using C/C++ language or hardware design using hardware description languages, the EDK enables the integration of both hardware and software components of an embedded system. For the hardware side, the design entry from VHDL/Verilog isfirst synthesized into a gate-level net list, and then translated into the primitives, mapped on the specific device resources such as Look-up tables, flip-flops, and block memories. are then placed and routed to meet with the timing Constraints.

V.EXPERIMENTAL RESULTIST

Fig.4 output.

VI. CONCLUSION

In this paper, we implement the using Spartan 3 EDK kit using System C coding. As discussed in this paper, a new architecture of home energy management using smart grid communication has revisited the need for domestic energy management for efficient consumption of electricity in smart grid. Consuming electrical energy efficiently results in reducing peak load, lowering electricity bills and minimizing the power consumption. In smart grid where there is wireless communication and better home automation, effective home energy management system can be designed. This proposed methodology has discussed home energy management schemes where different energy scheduling, pricing schemes have been applied to get economical and social advantages.

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