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Based on Zigbee Smart Home Energy Management System Using Renewable Energy

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ABSTRACT:
In this application we can generate the energy using renewable energy sources one is by using solar energy, another one is wind mill and one more the optional source is conventional power. These energy sources we are connecting to the grid via battery and inverter, Parallel the battery output is connected to micro controller unit and these micro controller is connected to LCD for displaying which source is available and also for displaying the battery voltage. Whenever the load is connected some units will be consumed, these units will be calculated and displayed on the LCD by using controller and the total transmitter section information is transmitted to receiver section and displayed on the PC through a wireless communication by using Zigbee technology. This project uses regulated 5V, 750mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

Keywords:
Raspberry-pi module, ARM Cortex-A7 Processor.

INTRODUCTION:
As home energy use is increasing and renewable energy systems are deployed, home energy management system (HEMS) needs to consider both energy consumption and generation simultaneously to minimize the energy cost. Here a smart HEMS architecture that considers both energy consumption and generation simultaneously.

ZigBee based energy measurement modules are used to monitor the energy consumption of home appliances and lights. The current energy crisis has required significant energy reduction in all areas. The energy consumption in home areas has increased as more home appliances are installed. Energy saving and renewable energy sources are considered as methods of solving home energy problem. Both energy consumption and generation should be simultaneously considered to save the home energy cost.

Energy Management and Communication Unit (EMCU):
In the energy consumption part, the EMCU is a key component; it is composed of measurement and communication blocks. The measurement block measures the power, energy, and power factor of plugged home appliances. It uses an energy metering IC for measuring them. The metering IC measures the voltage and current in a sample period; it multiplies them; it integrates them continuously. The power and energy is calculated with this process. The power factor is measure based the phase difference between voltage and current. The measurement block stores only the accumulated energy data at a memory; it calculates the power and power factor on demand in real time. The measurement block includes the power control block that supplies or blocks the electricity to connected home appliances. Solar Panel: A solar panel is consists of many Photo voltaic cells. It used to absorb the sun rays at day time and take a backup for use it night time. In today world the usage of the solar panel is very high to reduce the power consumption.

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To increasing the power generation in solar panel by using Maximum Power Point Tracking Technique. This technique can be simply done by using two LDR and a DC motor.

Wind turbine:

Wind turbine is used to absorb the wind from atmosphere and using the kinetic energy from wind to generate the electrical power. Battery with Charge controller: Here 12v battery can be used to store the power from wind turbine and solar panel. Both can produce above ranges then it can be controlled by using Charge controller circuit. Here a NPN transistor should be used to provide the safety purpose for drive the power from renewable energy to battery supply and maintain to don't send the power from battery to renewable energy sources such as solar panel and wind turbine.

Inverter:

It can be used to convert the 12v to 230v supply for providing the power to the home appliances form solar and wind. Step up transformer can be used to increase the power from 12v–230v power supply.

Current Sensor:

Current sensor is a device used to sense the current from solar panel, wind turbine and main panel for knowing the power generation and consumption by home appliances.This current sensor is worked based on the principle of Hall Effect. To convert the current into power by using the P=VI formula. It is also possible to measure the DC and ac supply directly from the source.

Zigbee:

It is the wireless device for transmitting and receiving purpose or simply it called as Transceiver. Zigbee is based on the IEEE802.15.4 protocol. The range of the Zigbee is covered as 100m. It range is 10 times better than bluetooth device so it can be more preferable one in wireless device. The data rate is very low for transmission while using this device.

The communication block supports data transfer between the EMCU and the home server. It adopts ZigBee and IEEE802.15.4 wireless personal area network (WPAN) as communication methods. It transfers not only the measured energy, power, and power factor but also the voltage and current. ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices. WPAN Low Rate or ZigBee provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. ZigBee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit. The ZigBee Alliance, the standards body which defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. The current list of application profiles either published or work in the home automation, zigbee smart energy, telecommunication applications, personal home.

RASPBERRI-PI:

The Raspberry Pi has a Broadcom BCM2836 system on a chip (SoC), which includes an a quad-core Cortex-A7 cluster. The Cortex-A7 MPCore processor is a high-performance, low-power processor that implements the ARMv7-A architecture. The Cortex-A7 MPCore processor has one to four processors in a single multiprocessor device with a L1 cache subsystem, an optional integrated GIC, and an optional L2 cache controller.

Fig.Raspberry Pi

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the

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teaching of basic computer science in schools. The Raspberry Pi is manufactured through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. All of these companies sell the Raspberry Pi online.

BASIC HARDWARE OF RASPBERRY-PI:

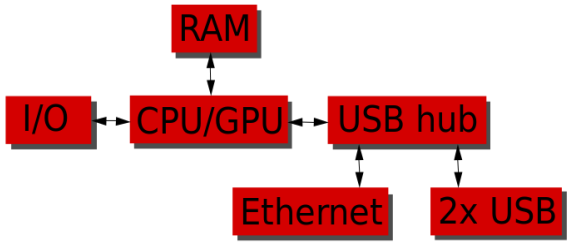

Fig. Basic Hardware of Raspberri-PI

Raspberry Pi 2 Model B specifications

- SoC – Broadcom BCM2836 quad core Cortex A7 processor @ 900MHz with VideoCore IV GPU
- System Memory – 1GB LPDDR2
- Storage – micro SD card slot (push release type)
- USB – 4x USB 2.0 ports, 1x micro USB for power
- 2×20 pin header for GPIOs
- Camera header & Display header
- Power – 5V via micro USB port.

CORTEX-A7 PROCESSOR:

The ARM Cortex-A7 processor is the most power-efficient multi-core processor. The Cortex-A7 powers sub-$100 entry-level smart phones, as well as a number of high-end wearable devices. The processor led the multicore revolution for entry-level and mid-range mobile smart phones, and devices based on the quad- and octa-core configurations are shipping in huge volumes. The Cortex-A7 processor is architecturally aligned with the high-performance Cortex-A17 and Cortex-A15 processors, enabling devices based on big. LITTLE™ technology.

The Cortex-A7 processor is supported by a suite of optimized IP targeted at mid-range solutions, bringing highest efficiency levels and ease of integration. All of our Mali™ mid-range and high-end graphics processors can be integrated with the Cortex-A7, as well as the Mali-V500 video processor and Mali-DP500 display processor. Our pervasive range of physical and system IP is also available as standard. The Cortex-A7 processor is a very energy-efficient applications processor designed to provide rich performance in entry-level to mid-range smart phones, high-end wearables, and other low-power embedded and consumer applications. It provides up to 20% more single thread performance than the Cortex-A5 and provides similar performance to mainstream Cortex-A9 based smart phones in 2012 while consuming less power. It has been licensed by many of the industry's leading silicon manufacturers including Broadcom, Freescale,HiSilicon, LG, Samsung, Texas Instruments, and many others.

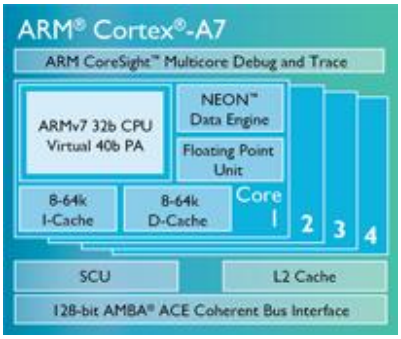

Fig.ARM Cortex-A7 Processor

The Cortex-A7 incorporates all features of the high-performance Cortex-A15 and Cortex-A17 processors, including virtualization support in hardware, Large Physical Address Extensions (LPAE), NEON™, and 128-bit AMBA® 4 AXI bus interface.The Cortex-A7 processor is widely used as an energy-efficient LITTLE CPU with a high-performance Cortex-A15 or Cortex-A17 processor to enable ARM big. LITTLE processing. The LITTLE Cortex-A7 processor runs low processing intensity tasks such as scrolling through the contents of a web page, texting, emailing and playing audio, while the big processor (Cortex-A15 or Cortex-A17) manages periods of high

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processing intensity tasks such as initial web page rendering and game physics calculation. This reduces overall energy consumption and improves processing performance while extending battery life. The software can run seamlessly on the Cortex-A7 and on both the Cortex-A15 and Cortex-A17 processors as needed without recompilation.

Applications Of Processor:

The Cortex-A7 is designed for use in a wide range of devices with differing requirements, from high-end wearables which demand a balance between power and performance, to high-end smartphones which can make use of a big. LITTLE configuration.

ADVANTAGES:

- Saving of money
- Easy to implement
- Easy maintenance
- Using of renewable energy

APPLICATIONS:

- Energy cost can be reduced
- Increase the power generation
- Energy Monitoring
- Know the cost of energy usage

CONCLUSION:

The smart home energy management system is works well on real time. The system can be fully controlled by controller. Power consumption details are successfully uploaded into the web server continuously. Solar power and wind energy are enough for production of power to supply the home appliances. The implementation cost of the system is low and this System is also reducing the cost of the power. During peak hour the heavy load home appliances kept off to maintain the energy management and save the energy for nature and upcoming future generations. The benefits are we can not only have the power but also have the knowledge of consumption.

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