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Smart Home Energy Management System Including Renewable Energy Based on Zigbee and GSM

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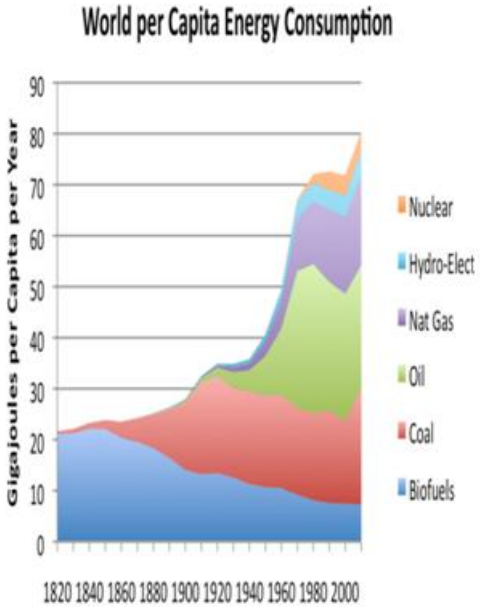
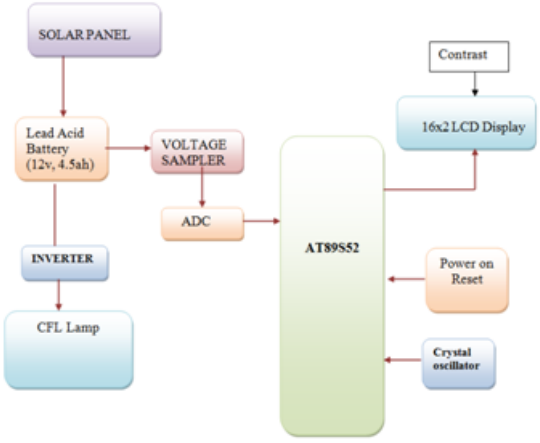
Abstract:
As home energy use is increasing and renewable energy systems are deployed, home energy management system (HEMS) needs to consider both energy consumption and generation simultaneously to minimize the energy cost. In this application we can generate the energy using renewable energy sources one is by using solar energy, another one is wind mill and one more the optional source is conventional power.



Existing System:
We can power our house by using solar panels by placing them on the roof and then connected to the battery and the battery is connected to the inverter. A solar inverter is a piece of the solar energy puzzle. Its purpose is to change the direct current (DC) electricity that is generated from a photovoltaic panel into an alternating current (AC) that can be used by in-home appliances and the community electricity grid. Because all photovoltaic panels produce electricity in DC, an inverter is required for all solar power systems to make the electricity usable.



Drawback:
Only one source is used to generate power. There is no calculation of utilized power

Proposed System:
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, Parallely the battery output is connected to micro controller unit and these microcontroller 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

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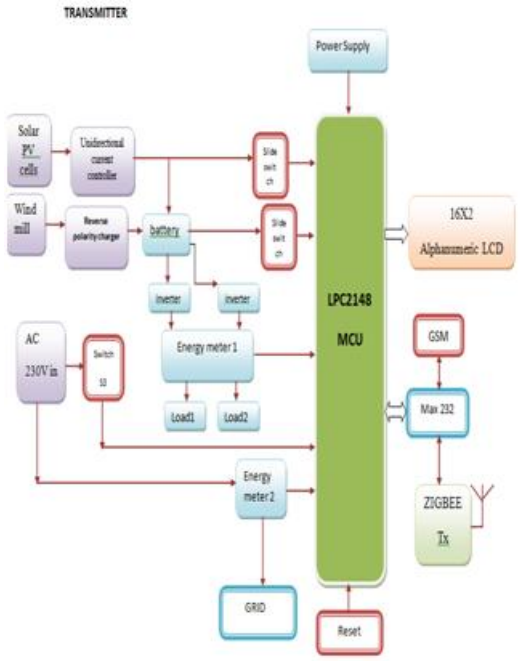
information is transmitted to receiver section and displayed on the PC through a wireless communication by using Zigbee technology. A GSM modem is also interfaced to the controller to send SMS.



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.

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. 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.

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It is also possible to measure the DC and ac supply directly from the source.

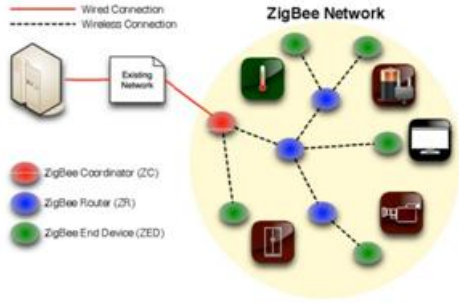
LPC2148

Key features

- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory.
- 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
- In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader
- Software. Single flash sector or full chip erase in 400 ms and programming of
- 256 bytes in 1 ms.
- Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the
- On-chip RealMonitor software and high-speed tracing of instruction execution.

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. It adopts ZigBee and IEEE 802.15.4 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.



The MCU in the communication block controls the state of the power control block in response to the command from the home server.

Energy (4B)	Power (3B)	Voltage (3B)	Current (3B)	Power Factor (2B)

Data transfer message format in a ZigBee payload

Technical Specifications of Zigbee:

- Frequency band2.400 — 2.483 GHz
- Number of channels16
- Data rate250 kbps
- Supply voltage1.8 – 3.6 V
- Flash memory128 kB
- RAM8 kB
- EEPROM4 kBOperating
- Temperature-40 — +85 °C

GSM:

Modem Specifications:

The SIM300 is a complete Tri-band GSM solution in a compact plug-in module. Featuring an industry-standard interface, the SIM300 delivers GSM/GPRS900/1800/1900Mhz performance for voice, SMS, data and Fax in a small form factor and with low power consumption. The leading features of SIM300 make it deal fir virtually unlimited application, such as WLL applications (Fixed Cellular Terminal), M2M application, handheld devices and much more.

1. Tri-band GSM/GPRS module with a size of 40x33x2.85
2. Customized MMI and keypad/LCD support

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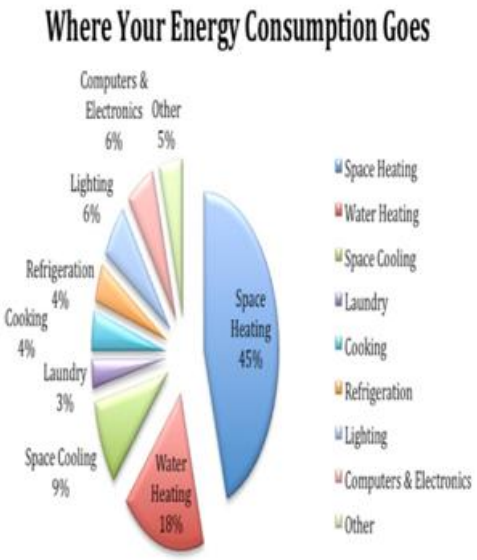
3. An embedded powerful TCP/IP protocol stack
4. Based upon mature and field proven platform, backed up by our support service, from definition to design and production.

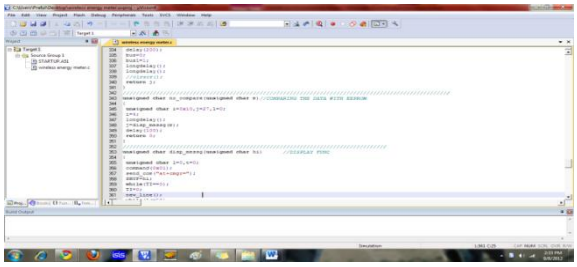
Applications:

1. Energy cost can be reduced
2. Increase the power generation
3. Energy Monitoring
4. Know the cost of energy usage



Software Tools:

Keil compiler is a software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code.



Flash Magic:

Flash Magic is a tool which is used to program hex code in EEPROM of micro-controller. It is a freeware tool. It only supports the micro-controller of Philips and NXP.

It can burn a hex code into that controller which supports ISP (in system programming) feature. Flash magic supports several chips like ARM Cortex M0, M3, M4, ARM7 and 8051.

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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