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Implementation of Renewable Home Energy Systems Using Arm Cortex Processor

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ABSTRACT

In this application we can generate the energy using renewable energy sources one is by using solar energy and one more the optional source is conventional power .These energy sources we are connecting to the grid via battery and inverter, Parallelly 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 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: ***—Home Energy Management System, ARM CORTEX Processor, ZigBee, Renewable Energy, Power Line Communication.***

1. INTRODUCTION

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. A good example is the microwave oven. Almost every household has one, and tens of millions of them are used every day, but very few people realize that a processor and software are involved in the preparation of their lunch or dinner. This is in direct contrast to the personal computer in the family room. It too is comprised of computer hardware and software and mechanical components (disk drives, for example). However, a personal computer is not designed to perform a specific function rather; it is able to do many different things. Many people use the term general-purpose computer to make this distinction clear. As shipped, a general-purpose computer is a blank slate; the manufacturer does not know what the customer will do wish it. One customer may use it for a network file server another may use it exclusively for playing games, and a third may use it to write the next great American novel. Frequently, an embedded system is a component within some larger system. For example, modern cars and trucks contain many embedded systems. One embedded system controls the antilock brakes, other monitors and controls the vehicle's emissions, and a third displays information on the dashboard. In some cases, these embedded systems are connected by some sort of a communication network, but that is certainly not a requirement. Given the definition of embedded systems earlier is this chapter; the first such systems could not possibly have appeared before 1971.That was the year Intel introduced the world's first microprocessor. This chip, the 4004, was designed for use in a line of business calculators produced by the Japanese Company Busicom. In 1969, Busicom asked Intel to design a set of custom integrated circuits, one for each of their new calculator models. The 4004 was Intel's response rather than design custom hardware for each calculator, Intel proposed a general-purpose circuit that could be used throughout the entire line of calculators. Intel's idea was that the software would give each calculator its unique set of features.

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Overview of Embedded System Architecture:

Every embedded system consists of custom-built hardware built around a Central Processing Unit (CPU). This hardware also contains memory chips onto which the software is loaded. The software residing on the memory chip is also called the 'firmware'. The embedded system architecture can be represented as a layered architecture as shown. The operating system runs above the hardware, and the application software runs above the operating system. The same architecture is applicable to any computer including a desktop. It is not compulsory to have an operating system in every embedded system. For small appliances such as remote control units, air conditioners, toys etc., there is no need for an operating system and you can write only the software specific to that application. For applications involving complex processing, it is advisable to have an operating system. In such a case, you need to integrate the application software with the operating system and then transfer the entire software on to the memory chip. Once the software is transferred to the memory chip, the software will continue to run for a long time you don't need to reload new software.

2. ARM-CORTEX M4

Texas Instrument's Tiva™ C Series microcontrollers provide designers a high-performance ARM® Cortex™-Mbased architecture with a broad set of integration capabilities and a strong ecosystem of software and development tools. Targeting performance and flexibility, the Tiva™ C Series architecture offers a 80 MHz Cortex-M with FPU, a variety of integrated memories and multiple programmable GPIO. Tiva™ C Series devices offer consumers compelling cost-effective solutions by integrating application-specific peripherals and providing a comprehensive library of software tools which minimize board costs and design-cycle time. Offering quicker time to-market and cost savings, the Tiva™ C Series microcontrollers are the leading choice in high-performance 32-bit applications.

Fig.1: ARM Cortex M3-TI Microcontroller

3. ZIGBEE

ZigBee is a IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics.

ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 k bit/s, best suited for intermittent data transmissions from a sensor or input device. ZigBee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive.

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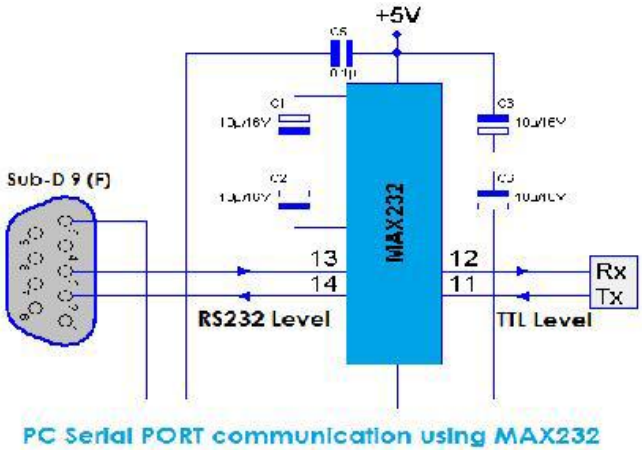
Fig.2.ZIGBEE

ZigBee is a low-cost, low-power, wireless mesh network standard targeted at wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB flash memory. ZigBee operates in the industrial, scientific and medical (ISM) radio bands:2.4 GHz in most jurisdictions worldwide; 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and Australia. Data rates vary from 20 k bit/s (868 MHz band) to 250 k bit/s (2.4 GHz band).



PC Serial PORT communication using MAX232

Fig.3.ZIGBEE TO PC

The original 2003 version of the standard specifies two physical layers based on direct sequence spread spectrum(DSSS) techniques: one working in the 868/915 MHz bands with transfer rates of 20 and 40 k bit/s, and one in the 2450 MHz band with a rate of 250 k bit/s. The 2006 revision improves the maximum data rates of the 868/915 MHz bands, bringing them up to support 100 and 250 k bit/s as well. Moreover, it goes on to define four physical layers depending on the modulation method used.

ZigBee is Reliable:

ZigBee harnesses the power of the mesh to connect every product to every other product. So if one of your products fails, the others will continue to communicate without interruption.

ZigBee is Interoperable:

ZigBee standardizes everything from basic communication to how a product operates. Products with the ZigBee logo work together seamlessly, even if they're from different companies. ZigBee allows devices to last for years on a single battery. With the Green Power Feature, you don't even need any batteries!

4. RENEWABLE ENERGY

Solar panel:

A solar panel is a device that collects photons of sunlight, which are very small packets of Electromagnetic radiation energy, and converts them into electrical current that can be used to power electrical loads. Using solar panels is a very practical way to produce electricity for many applications. The obvious would have to be off-grid living. Living off-grid means living in a location that is not serviced by the main electric utility grid. Remote homes and cabins benefit nicely from solar power systems. No longer is it necessary to pay huge fees for the installation of electric utility poles and cabling from the nearest main grid access point. A solar electric system is potentially less expensive and can provide power for upwards of three decades if properly maintained. Besides the fact that solar panels make it possible to live off-grid,

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perhaps the greatest benefit that you would enjoy from the use of solar power is that it is both a clean and a renewable source of energy With the advent of global climate change, it has become more important that we do whatever we can to reduce the pressure on our atmosphere from the emission of greenhouse gases. Solar panels have no moving parts and require little maintenance.

Polycrystalline and Amorphous thin film solar cell:

Daily to see the solid is divided into two major categories of non-crystalline and crystalline, non-crystalline arrangement of atoms within the material is not necessarily the law of the fracture when the fracture is random, such as plastic and glass, and called the crystal material, represent the natural shape of a regular polyhedron, with obvious edges and corners with the plane, the atom is in accordance with its internal law must line up neatly, so when they break off the plane according to certain, such as salt, crystal and so on.

Monocrystalline silicon solar cells:

Monocrystalline silicon solar cells is currently the fastest developing a solar cell, its composition and production technology has been finalized, the products have been widely used for space and ground facilities. The high purity single crystal silicon solar cells as the raw material rod, 99.999% purity.

Fig.4.Solar Panel

INVERTER:

The ability of an SCR to control large currents to a load by means of small gate current makes the device very useful in switching and control applications.

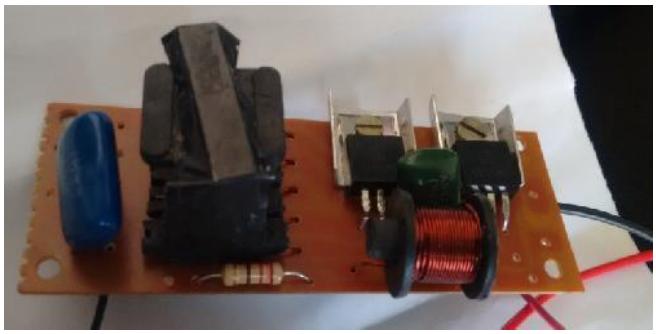

Fig.5.Inverter circuit

A few of the possible applications for the SCR are listed in the introduction to SCR blog post.
Here we will consider six applications of SCR like power control, switching, zero-voltage switching, **over**, **pulsecircuits** and battery charging regulator.

5.CIRCUIT AND RESULTS

Fig.6.Transmitting Section (Without Load)

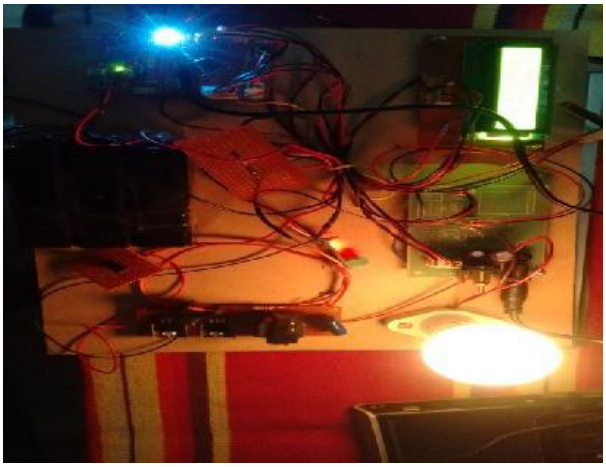

Fig.7.With Load

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6. CONCLUSION

The home server can estimate the energy generation based on a weather forecast. Using the obtained energy information, the home server can control the home energy use schedule to minimize the energy cost. Users can access the home energy information through smart devices. The REMS provides the comparison and analysis of each home energy usage. By considering both consumption and generation, the proposed architecture is expected to enhance home energy management and to save the energy cost. As residential homes have installed renewable energy sources to save the energy cost, it is important that both energy consumption and generation are simultaneously considered in HEMS.This paper proposes the smart HEMS architecture that considers both consumption and generation. In the energy consumption, the EMCUs are installed in outlets and lights to measure the energy usages of home appliances and lights based on ZigBee; they transfer the gathered data to the home sever. With this scheme, the home server figures out the home energy usage pattern. In the energy generation, PLC modems are installed in each solar panel to monitor its status.

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