International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Power Adaptive Computing System Design using Embedded System

Akash Uplenchwar[1], S. S. Palnitkar[2]

[1]Department of Electronic and Telecommunication, Zeal College of Engineering and Research, Pune, India

[2]Department of Electronic and Telecommunication, Zeal College of Engineering and Research, Pune, India

Abstract: ***Due to the energy harvesting system, immediately new energy sources are available for many advanced applications which are based on environmentally embedded systems. There are various harvested power like the solar energy, varies significantly under the various conditions, which affects the conversion of energy. In this paper, we propose the approach for designing new power-adaptive computing systems to increase the energy utilization under different solar power supply. Using the techniques which use geometric programming, the proposed approach can generate a parallel computing structure. Then, based on the estimation of the solar energy in the future time slots. A convex model-based adaptation strategy which is used to restrain the power behavior of the real time computing system. The developed power adaptive computing system is executed on the hardware and calculated by a solar harvesting system simulation for five applications. It shows that the developed power-adaptive systems which can track the various power supply. The present design approach for self powered embedded systems has a better utilization of energy sources.***

Keywords: Design optimization, energy harvesting, power adaptation

1. Introduction

Environmentally embedded systems have developed speedily in recent years. Energy harvesting embedded system model in various environments, such as forests, rivers, buildings, and industries to monitor energy harvesting in the change of environmental conditions. A critical concern with regards to the design of the environmentally embedded systems is how to supply the electrical power for both readily and reliably to allow the systems work continuously. Batteries with limited potential are not an economical solution. Energy harvesting powered system needs to adapt to the unstable nature of the surrounding energy. Hence, the power adaptability is one of the major design advantages for the system. Power adaptability improves the system behavior according to change the external power supply and thus allows the system to work for a long time. The energy harvester converts surrounding energy to electricity. The power can be absorb from the harvester and performs ac to dc or dc to ac conversion with the goal of transferring as much power as possible to the energy storage or application unit. The energy storage buffers the harvested energy temporally and supplies energy to the application system, the embedded application-specific functional unit. If the harvested energy exceeds the energy consumed by the application system and the system is directly powered by the harvester and the surplus will charge the energy storage. To improve the energy conversion efficiency, studies on various system modules shown in Fig. 1.

A reconfiguration algorithm was proposed to increase the power conversion efficiency of a solar. A low-power maximum power point tracking controller that implemented to achieve an efficient power converter, while a control algorithm for dc–dc converters was developed.

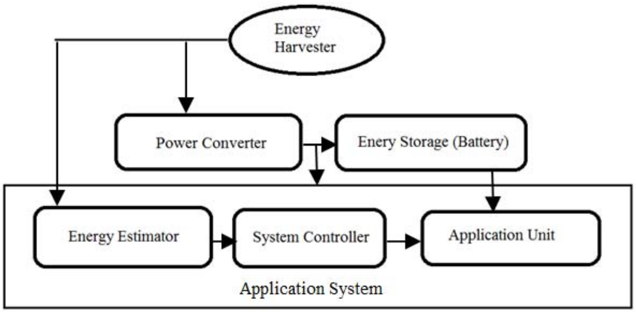


Figure 1: System Module

An efficient charging method for energy storage super capacitors was presented to improve buffering efficiency. Power management techniques to improve the consumption efficiency for the embedded application system were developed. However, most existing solar-energy-powered embedded systems, such as the wireless sensor networks, lack this capability. A design approach for the power adaptive computing system, which equips the environmentally embedded systems with the required computing capability. We propose a thorough approach for designing and maintaining the power adaptive computing system. A low speed homogenous processing unit is designed with various design optimization techniques for a parallel computing structure. Here the power profile regulates clocking technique using designed computing unit At run time, simplified geometric programming problems are solved to determine which PUs is clock-gated ON/OFF for a particular time slot.

V. Raghu Nathan and P. H. Chou addressed the drawbacks in the design of harvesting systems. It also explained the different techniques which gives high conversion and storage efficiency so that for consumption maximum energy is available.[1]

C.Lu,V. Raghu Nathan, and K. Roy described the energy harvesting system which is based on micro-scale.It solves the problem of optimization rather than using online systems.[2]

Q. Liu, T. Mak, J. Luo, W. Luk, and A. Yakovlev explained the control method for energy harvesting which reduces the storage use. It explains the strategy which tries to match the rate of transmission to the harvested power availability which helps to minimise the storage capacity.[3]

Here we also extend the design optimization techniques to design the parallel computing unit and the system controller with practical considerations. They are integrated with an energy estimator to provide a thorough solution for designing and managing the power-adaptive computing system. The proposed approach is comprehensively evaluated in various solar energy contexts.

Existing System was work on low-power design concept i.e once the power supply decreases the working load get shut down or stop working. In contrast, the design goal of the power-adaptive computing systems in this paper is to maximize the system performance, under the constraint that the power consumption does not exceed the amount of power supply available. This constraint is also known as the energy neutral mode.

2. System Architecture

Three components is compute in adaptive computing system: the energy estimator, the system controller, and the computing unit. The power adaptation strategies are classified into two parts: the numerical model-base strategies and the rule-based. The former switches the system process modes according to predefined rules, which specify a process mode for a power supply range.

When the load start consuming more power than the harvested there after it turn off the low priority processing unit after following the rules or it will switch the load to storage device i.e battery for better performance when the power harvesting is stopped due to some environmental changes.

Below figure shows overall block diagram of the system. figure 2. Shows the power is consumed by load and controller monitor the harvested power.

Here LCD is used to visualize the output of the application. It is available size is 16x2 which indicates 16 columns and 2 rows. LCD display write 16 characters in each line so LCD display consist total 32 characters. The alternating electric currents is measure by current transformer (ct). Voltage transformers (vt), (potential transformers (pt)) together with Current transformers are known as instrument transformers. When current in a circuit is very high to apply directly on measuring instruments, simultaneously a current transformer produces a reduced current accurately which is proportional to the current in the circuit. A current transformer isolates the measuring instruments from what may be very high voltage in the monitor circuit. In the electrical power industry mostly current transformers are commonly used for protecting and metering relays.

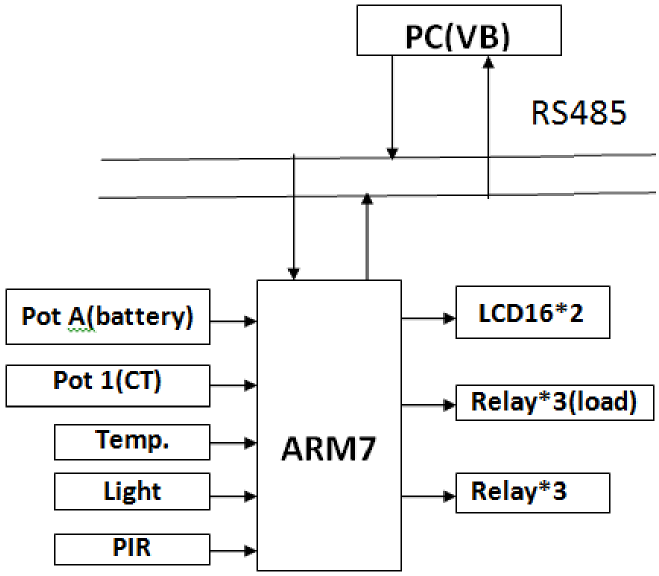


Figure 2: Block diagram of controller

A temperature above absolute value i.e zero will start emiting heat energy in the form of radiation with all object but unfortunately this radiation is not visible to the human eye because it radiates at infrared wavelengths. To make it visible electronic devices is designed for such a purpose

Over long a distances small block of information transfer, RS-485 is used. The PCs, microcontrollers, or any devices capable of communicating with asynchronous serial communications. RS-485's hardware and protocol requirements are simpler and cheaper as we compared with Ethernet and other network interfaces. The RS-485 is flexible to provide a choice of receivers, drivers and other components depending on number of nodes, data rate, cable length, and the need to conserve power.

3. Component of Proposed System

ARM7 (LPC2138):- In this implementation we are using LPC2138 controller, which has two 8 channel 10 bit ADC which provides up to 16 analog inputs from which we are just using two pins, one for temperature sensor and another for light sensor. It has multiple serial interface including programmable serial UARTs which are used to burn the core program in controller.

Temperature sensor LM35:- It directly calibrates the temperature in Celsius (Centigrade). This is the advantage to use this sensor over linear sensor, which gives the direct reading in Celsius scaling not in kelvin. The range of this sensor is normally from -55°C to 150°C and operates from 4 V to 30 V and linear + 10-mV/°C Scale Factor.

Light dependent resistors (LDR):- It has two cadmium sulphide (CdS) photoconductive cells with the spectral responses which is similar to that of the human eye. The cell resistance falls with increasing light intensity. It is use to smoke detection, automatic lighting control, batch counting. Photo resistors or Light Dependent Resistors (LDR) which are used to change resistance according to light intensity.

Passive Infrared (PIR) Sensor: All objects with a temperature value above zero emit the heat energy which is in the form of radiation. Basically this radiation is invisible to the human eye because they radiate at infrared wavelengths, but this radiation can be detected by electronic devices designed for this purpose.

RS 485: When a network needs to transfer information over long distances, RS-485 is used. The network nodes can be PCs, microcontrollers, or any other devices capable of asynchronous serial communications. With compared to Ethernet and other network interfaces, the RS-485's hardware and protocol requirements are simpler and cheaper.

Solar Panel: We used 12 volt, 3 watt solar panel which gives the constant 0.25 Ampere current supply on full light intensity.

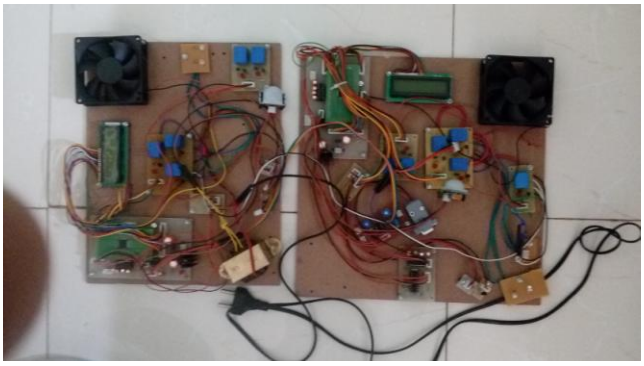
Battery: We used 12 Volt 48 Watt Battery to store the excess power harvested from panel.

Relay (RW/RWH):- Here we use RW switching relay to manage the load switching. It required 12A at 120VAC for RW switching relay and 12A at 240VAC for RWH switching relay. The maximum switching (ON/OF) capacity is 130 Ops per minute (Mechanical) and 30 Ops per minute (Electrical)

LED:- Here we used the 5MM LED, which required 130 mW power and it operates on (-55 to +100) C, It required the 40 mA forward current and 5V supply.

4. Implementation

In this implementation we used the Solar panel to extract the solar energy, the battery is used to store the excess harvested power, microcontroller (LPC2138), load (fan, LED), temperature sensor, light sensor, PIR. The solar energy is extract from the nature with the help of solar panel and gives to the converter, the converter is used to convert the DC to AC and passed to the controller to run the load, the excess harvested power is stored in the storage device i.e. battery. The controller read the input voltage from the solar panel and compares the input voltage with the voltage range for load. If the solar voltage is less than the set voltage range then controller switch the input source as a battery and again the same voltage range comparison is processed as above.



Once the expected voltage range is get from the input source then this voltage parameter is send to the VB program, here we used the VB Programming to operate the load programmatically and microcontroller programming is used to operate the load as per the criteria set. Visual basic provides the riches user interface to visualize the actual things happened behind the circuit. I provide the ability to make the run time changes for operating the load. The 16 pin LCD display is used to show the scanning process for reading the input voltage from the input devices. This process is run continuously and takes the decision according to criteria set. We developed the battery estimators program to estimates the battery for better use and run the most important device continuously without any hardness. The estimator continuously checks the remaining power from the battery and inform to the decision maker to run the load. Here we used many sensor to utilized the power more effectively, the temperature sensor is used to auto operate the temperature dependent devices like fan. We used the motion sensor PIR to detect the motion in the specified area and operate the load as per the necessity. The light sensor is used to check the light intensity and accordingly we can operate the light dependent devices like LED, Lamp.

Here we implement the master and slave processing unit architecture which will operate on external energy source.
The slave processing unit is kept as a low priority processing unit and the master is on high priority.

In each processing unit we use three load which will operate as per the decision making criteria. And for each load we connect the three different sensors like light, temperature, and motion. Which helps to save the unused power according to the condition set for three different sensor.

5. Result

All loads are operates on 12v and 0.25 A constant supply from solar panel with high intensity of light.

All load operate on 12v and mA constant power supply from fully charged battery.

The load switches (ON/OFF) according to the input supply from solar panel/ battery with accuracy 98%.

6. Advantages

- Less time delays
- Quick response time
- Fully automate system
- Robust system
- Low power requirement

7. Conclusion

The proposed system explains the skill for computing the embedded system powered solar energy. Here, the computing unit is designed which contains multiple parallel processing units having low speed. Hence, in run time, the system controller decides the number of clock-gated ON processing units by simplifying geometric programming model .In the overall system, there is increase in the speed and optimization in power consumption.

8. Acknowledgement

At the outset, I Akash Uplenchwar & Prof. S. S. palnitkar express my sincere thanks to referees, for there constant support and valuable suggestions without the completion of this paper is not possible. I would also like to thank Prof. V. B. Shere (H.O.D.) and Prof. R.C. Mahajan (P.G. Coordinator) for motivation & inspiration.

References

[1] V. Raghunathan and P. H. Chou, "Design and power management of energy harvesting embedded systems," in Proc. Int. Symp. Low Power Electron. Design (ISLPED), Oct. 2006, pp. 369–374. [2] C. Moser, L. Thiele, D. Brunelli, and L. Benini, "Adaptive power management for environmentally powered systems," IEEE Trans. Comput., vol. 59, no. 4, pp. 478–491, Apr. 2010.
[2] C. Lu, V. Raghunathan, and K. Roy, "Micro-scale energy harvesting: A system design perspective," in Proc. 15th Asia South Pacific Design Autom. Conf. (ASP-DAC), Jan. 2010, pp. 89–94.
[3] Q. Liu, T. Mak, J. Luo, W. Luk, and A. Yakovlev, "Power adaptive computing system design in energy harvesting environment," in Proc. Int. Conf. Embedded Comput. Syst., Archit., Model. Simul., Jul. 2011, pp. 33–40.
[4] C. Moser, L. Thiele, D. Brunelli, and L. Benini, "Adaptive power management in energy harvesting systems," in Proc. DATE, Apr. 2007, pp. 1–6.
[5] C. Moser, L. Thiele, D. Brunelli, and L. Benini, "Robust and low complexity rate control for solar powered sensors," in Proc. DATE, Mar. 2008, pp. 230–235.
[6] S. Liu, Q. Qiu, and Q. Wu, "Energy aware dynamic voltage and frequency selection for real-time systems with energy harvesting," in Proc. DATE, Mar. 2008, pp. 236–241.
[7] F. I. Simjee and P. H. Chou, "Efficient charging of supercapacitors for extended lifetime of wireless sensor nodes," IEEE Trans. Power Electron., vol. 23, no. 3, pp. 1526–1536, May 2008.
[8] B. Zhang, R. Simon, and H. Aydin, "Energy management for time-critical energy harvesting wireless sensor networks," in Proc. 12th Int. Symp. Stabilization, Safety, Secur. Distrib. Syst., 2010, pp. 236–251.
[9] A. B. Kahng, S. Kang, T. S. Rosing, and R. Strong, "Manycore token-based adaptive power gating," IEEE Trans. Comput.- Aided Design Integr. Circuits Syst., vol. 32, no. 8, pp. 1288–1292, Aug. 2013.