DEMO: SMART POWER UNIT FOR GREEN WIRELESS SENSOR NETWORK: PHOTOVOLTAIC HARVESTER

UNIVERSITY OF BOLOGNA

Green sEnsor NEtworks for Structural monitoring

GENESI develops structural health monitoring systems for critical infrastructures such as tunnels, bridges, dams, private and public buildings, providing cutting edge green wireless sensor networks technology

KEYWORDS: structural health monitoring, energy harvesting, wireless sensor networks

First Workshop

11th March, 9.30-17.00
Hilton – Amsterdam Airport Schiphol

Introduction

The operating lifetime of wireless sensor networks, as for many other battery-operated embedded systems, is a crucial design parameter. Electronic systems continue to shrink, less energy is storable on-board and this limits the system's lifespan.

University of Bologna contributes to the GENESI project by developing of a smart power unit (SPU) to extract energy from the environment and supply the electronic devices, increasing their autonomy. The Power Unit is designed as a smart battery and provides continuous power to the nodes and the sensors storing the converted energy into batteries or supercapacitors.

Moreover when the power converted from the surrounding environment sources is insufficient, the Power Unit will use special micro fuel-cells as last-option energy source to recharge the energy storage. Thus the SPU will consist in a multi-source energy harvester and one or more energy storages.

The figure shows the block diagram of the smart power unit. The hybrid power source consists of several devices (photovoltaic, air flow, etc) and the power storage is a battery that works together with supercapacitor and fuel cell. The charging and discharging of the battery and the supercapacitor as well as the fuel cell is managed by a power management stage, which also provides a digital interface to the node. In this way the nodes can get information about the status of energy resources to adapt parameters to extend the lifespan. On the other hand, the PMU can take additional information from supplied devices to optimize the conversion and the energy management.

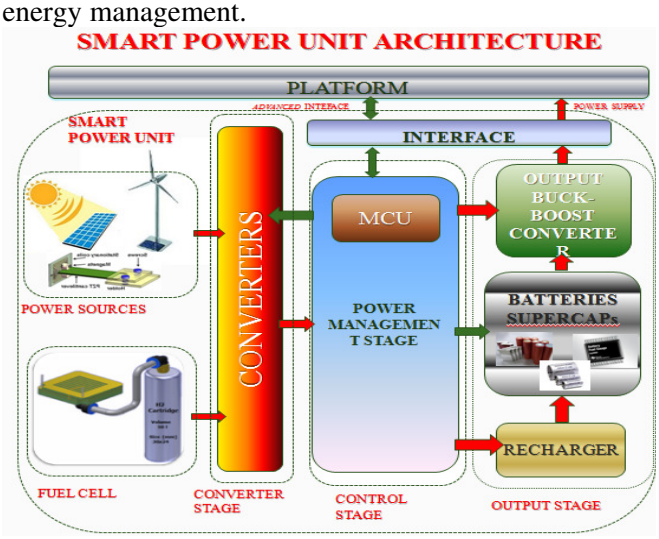

Figure 1 Smart power unite architecture

Solar harvester

We present the design, implementation and performance of a solar harvester prototype and we illustrate the features of the solar harvester unit such as the possibility to recharge different kind of storage

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(i-e supercaps and batteres). Moreover although currently only the solar harvester is fully operating, the unit is designed to be the core of multiharvester unit of final power unit as shown in the introduction. For this reason the PV can also host other harvester and especially wind power scavenger. Finally The unit provides information the state of storages and the environmental sources permitting the power platform to adapt the application parameters and to optimize the power consumption. Figure 2 and 3 shows the solar harvester and the architecture block diagram.

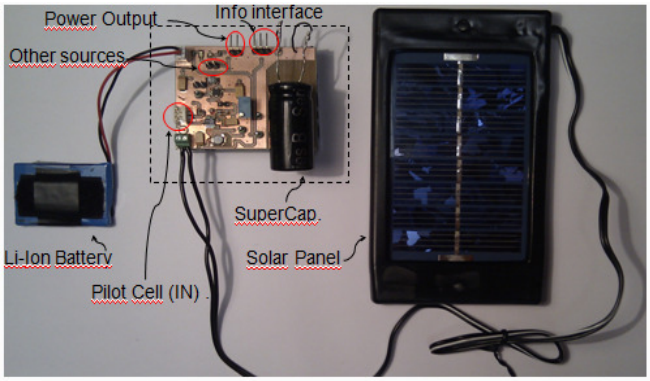

Figure 2 Solar harvester prototype

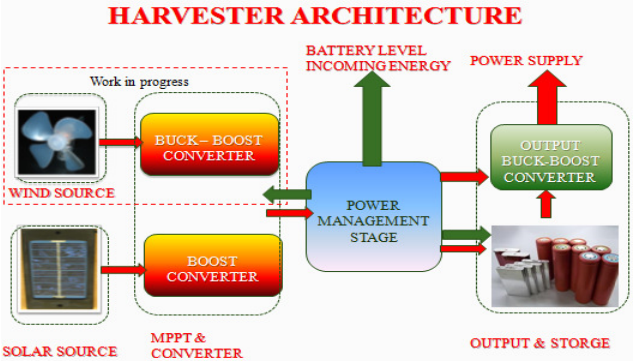

Figure 3 Solar harvestr architecture

Workshop Demo

The aim of the demo is to show how the solar harvester can supply a wireless sensor node, recharging different kind of energy reservoirs sach as batteries and supercapacitors. Moreover we will show how the interface of power unit provides information about voltage battery and voltage of solar panel.

To achieve these goals we will use as node the TI ez430 – RF2500T as supplied platform (figure 4) This board is based on the TI - MSP430 microcontroller and the CC2500 as radio transceiver . The choice of this board is motivated by the fact that GENESI platforms, designed from other partners, are based on the same cpu and similar radio, so the testbed is very close to the final project node. The demo platform will use a 115x67mm solar panel with a max power of about 400mW to supply the node and recharge a supercapitor (25F at 5V), a Li-Ion battery (700mAh at 4.2V), or 3 AA Ni-Mh batteries (.1300mAh at 1.2V)

Advance features provided by solar harvester are shown such as the possibility to read the battery state and the voltage of PV-module to estimate the incoming power.

Conclusion

The interest in small size power unit able to supply wireless platform will be one of goal for GENESI project. In this workshop we present an harvester unit designed for wireless sensor nodes which is able to harvest efficiently solar energy and it is ready to host wind harvestering. The unit can recharge batteries as well as supercapitors

The unit provides information about the state of storages and the environmental sources permitting the power platform to adapt the application parameters and to optimize the power consumption. We addressed different configurations using different kind of storages and characterized the system in terms of efficiency. Finally the board was designed and tested to recharge the storage by a hydrogen fuel cell as well.

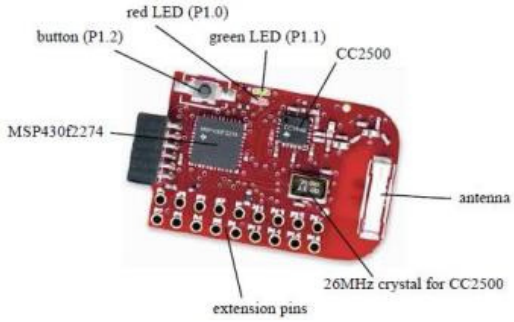

Figure 4 TI e430-RF2500T test node.

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