SMART POWER UNIT FOR GREEN WIRELESS SENSOR NETWORK: SOLAR HARVESTER

University of Bologna – Italy

*{**michele.magno**,davide.brunelli,luca.benini}@unibo.it*

GENESI: Green sEnsor NEtworks for Structural monItoring

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

Information Society

European Commission

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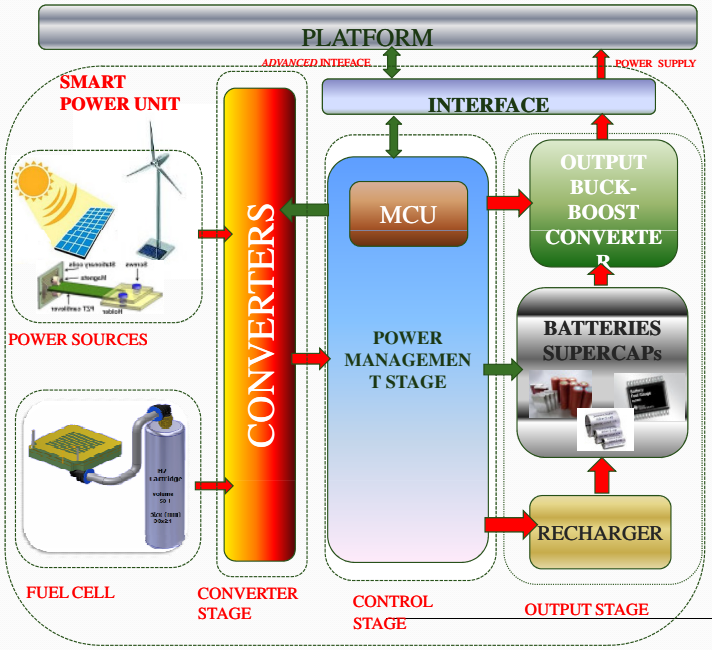
INTRODUCTION

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 the contributions in GENESI project by developing of a SMART POWER UNIT (SPU) capable to convert 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.

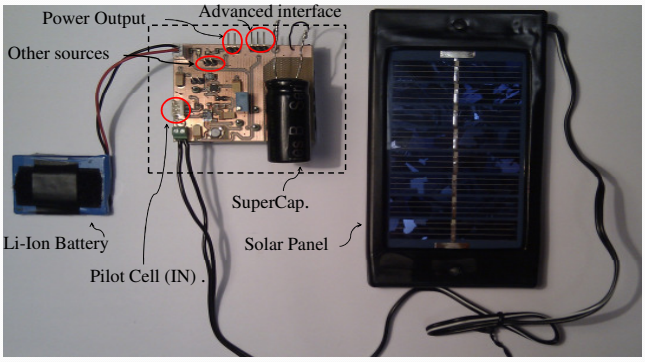
Moreover when the power converted from the surrounding environment sources is too low, the Power Unit will use special micro fuel-cells as last-option energy source to recharge the storage elements previously mentioned. Thus the SPU will consist in multi environmental energy harvester and one or more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

The following figure shows the block diagram of the smart power unit. The hybrid power source could consist in 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 cycles battery and the supercapacitor and as well as the fuel cell is managed by a power management stage. It provides also a digital interface to the node. In this way the nodes can get advanced information about 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.

SMART POWER UNIT ARCHITECTURE



CURRENT HARVESTER PROTOTYPE

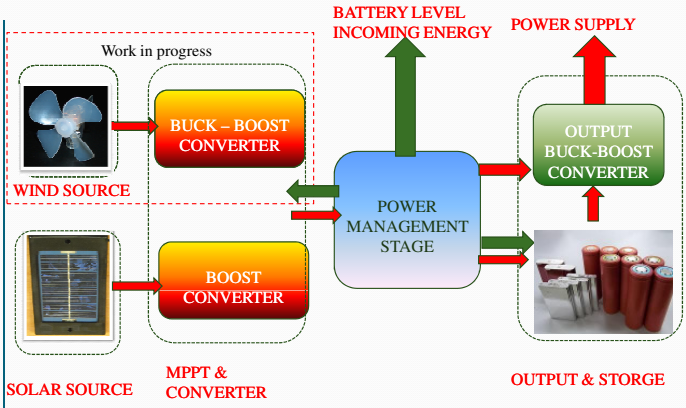


References

•**Design of a Solar Harvesting Circuit for Battery-less Embedded Systems**, Davide Brunelli, Clemens Moser, Lothar Thiele and Luca Benini (2009), in: IEEE Transactions on Circuits and Systems I: Regular Papers, 56:11(2519-2528)

•**GENESI: Green sEnsor NEtworks for Structural monItoring**, Luca Benini, Davide Brunelli, Chiara Petrioli and Simone Silvestri, in: Sensor Mesh and Ad Hoc Communications and Networks (SECON), 2010 7th Annual IEEE Communications Society Conference on, Boston, MA, pages 1 -3, 2010

HARVESTER ARCHITECTURE



EXPERIMENTAL RESULTS

Photovoltaic module Characterizations

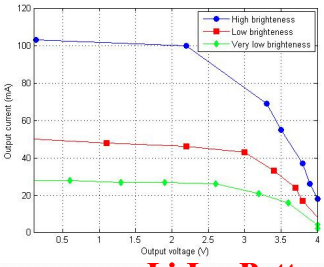
Dimension:	115x67mm
Max power voltage:	3.3.V
Current @ Maximum power point:	150mA

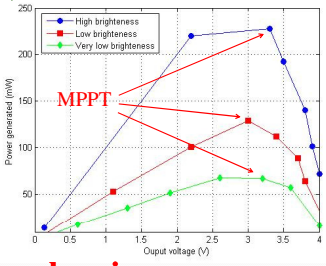
Harvester Characterizations

MPPT algorithm → $V_{MPP} \approx V_{OC} * K_{FOC}$

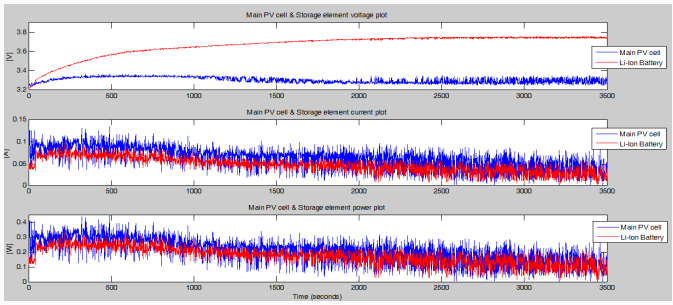
Li-Ion Battery efficiency → 82%

SuperCap efficiency → 70%

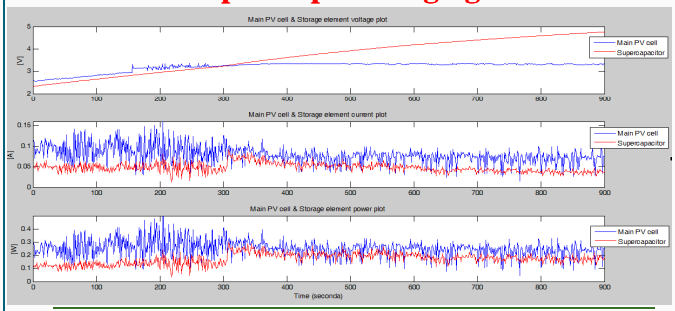




Li-Ion Battery recharging



Super Cap recharging



CONCLUSIONS

The interest in small size power unit able to supply wireless platform will be one of goal for GENESI project. In this workshop we have presented a harvester unit designed for wireless sensor nodes which is able to collect efficiently solar energy and which is ready to host additional harvesting modules.

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.