Europass
Curriculum Vitae

Personal information

Last and First name	**Bellasi Patrick**
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Nationality	Italian
Date of birth	February 14, 1979

Presentation

I'm currently a Post-Doc at DEIB - Politecnico di Milano - where I'm mainly involved with the EU sponsored 2PARMA project, focusing on run-time resource management.

I earned my PhD degree at Politecnico di Milano in 2009 under Professor William Fornaciari, working in tight collaboration with AST, the R&D division of STMicroelectronics, in a group headed by Diego Melpignano.

Prior to that I earned my master degree at the same University in 2005 and the high school degree in 1999 at the "Istituto Tecnico Scientifico - E. Mattei" - Sondrio, Italy.

My research interests are in the area of embedded systems, focusing especially on resource and power management. I'm interested in understanding current and future application trends and characteristics to help develop efficient embedded platforms in light of upcoming many-cores architecture challenges like resource management, task scheduling and aggressive power management, which are predominantly issues at the Operating System level.

I've become keen in applying my background on dynamic power management in the Linux kernel, targeting real platforms for mobile multimedia embedded systems, to address these optimization challenges by specifically taking a hardware-software co-design approach.

Because of my research experience and tight collaboration with companies like STMicroelectronics, I've gained a hands-on view on the importance and practical aspects of power optimization in mobile computing platforms like smartphones, which is the domain I'm focusing upon.

Education and Research

Dates	Since Jul 2010
Occupation or position held	Post-Doc at Politecnico di Milano.
Main activities and responsibilities	"Multi-many core architectures run-time resource management"
Name and address of employer	Politecnico di Milano
Dates	Jan 2007 - Dec 2009
Occupation or position held	Ph.D. Student in Computer Science
Main activities and responsibilities	"Cross-Layer Frameworks for Constrained Power and Resources Management of Embedded Systems"
Name and address of employer	Politecnico di Milano, STMicroelectronics. Advisor: Prof. William Fornaciari
Dates	Jan 2010 - Jun 2010
Occupation or position held	Junior Research Fellow – working within the 2PARMA 7FP international project.

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Main activities and responsibilities	"Resource and energy management in operating systems running on top of multi-many core architectures"
Name and address of employer	Politecnico di Milano
Dates	Jul 2006 - Dic 2006
Occupation or position held	University Researcher Assistant – working within STMicroelectronics on power management and optimization for MPSoC architectures.
Main activities and responsibilities	Power management and optimization on embedded Linux CE devices
Name and address of employer	Politecnico di Milano and STMicroelectronics
Dates	1998-2005
Title of qualification awarded	Computer Science Engineering
Principal subjects/Occupational skills covered	Software Engineering and Embedded System Design
Master Degree Thesis Title	Simple Power Analysis a livello di Instruction Set Architecture: modelli, metodi e strumenti
Name and type of organization providing education and training	Politecnico di Milano - Italy
Level in national or international classification	100/100
Dates	1993-1998
Title of qualification awarded	Non-graduate Engineer in Computer Science
Principal subjects/Occupational skills covered	Computer Science
Name and type of organization providing education and training	Istituto Tecnico Industriale "E. Mattei", Sondrio - Italy
Level in national or international classification	60/60

Work Experience

Dates	Since May 2006
Occupation or position held	Freelance Consultant on embedded system solutions and opensource technologies
Main activities and responsibilities	Embedded system solutions design and application development on embedded Linux devices
Name and address of employer	Daricom Srl - via San Rocco, 13 - 20132 Milano - Italy
Type of business or sector	Automotive Security and Localization Systems
Dates	Oct 2005 - Dic 2005
Occupation or position held	Implementation Consultant on Parametric Technology
Main activities and responsibilities	Customization task for customers adopting one of the most widely used Java based PDM platform solutions
Name and address of employer	C. Dir. Colleoni, Palazzo Sirio 3 - V.le Colleoni, 11 - 20041 Agrate Brianza (Mi) Italy
Type of business or sector	Software House - complete PLM solutiuons

Research interests

Run-Time Resource Management for Multi/Many-Core Platforms	Resource management is becoming one of the most challenging topics for a proper exploitation of upcoming many-core computing devices. These devices, which are represented in first instance by general purpose GPUs (GPGPUs), are characterized by an increasing number of symmetric Processing Element (PE) which exposes a SIMD programming model allowing to execute concurrently the same kernel code on a wide input data-set. This kind of massive data parallelization allows to speed-up the overall processing time of a given workload by splitting the computational effort among multiple hardware processing resources. Meanwhile new programming paradigms and standards, like OpenCL, have been developed to extend the functional capabilities of existing programming languages, such as for example C/C++ and Fortran, and to support the developer on exploiting the computational capabilities of these parallel processing devices.

The research conducted has focused on the design and development of an highly modular and extensible run-time resource manager [**C.2**-**C.6**] which provide support for an easy integration and management of multiple applications competing on the usage of one (or more) shared MIMD many-core computation devices. The framework design, which exposes different plugin interfaces, provides support for pluggable policies for both resource scheduling [**C.3**] and the management of applications coordination and reconfiguration [**C.2**]. Applications integrated with this framework gets "for-free" a suitable instrumentation to support Design-Space-Exploration (DSE) techniques, which could be used to profile application behaviors to either optimize them at design time or support the identification of optimal QoS requirements goals as well as their run-time monitoring. Suitable platform abstraction layers, built on top of Linux kernel interfaces, allows an easily porting of the framework on different platforms and its integration with specific execution environments such as the Android run-time.

Based on all these features the framework allows an easily coding of resource management policies which support an optimized assignment of resources to demanding applications considering:

- application properties, e.g. run-time requirements, operating modes and relative priorities,

- resources availability and state, e.g. power and thermal conditions

- tunable run-time optimization goals, e.g. power reduction, energy optimization, reconfiguration overheads minimization and overall performances maximization.

An initial version of the proposed framework is already available and actively developed as an *Open-Source project*, the **Barbeque OpenSource Project (BOSP)**[1], which defines a new approach to develop a System-Wide RTRM supporting a comprehensive set of advanced features, such as:

- a hierarchical and distributed control

- the exploitation of design-time information

- a rich multi-objective optimization strategy

- a portable and modular design based on a set of tunable policies.

Power Management at OS level

The research conducted has focused on issues related to the dynamic management of power in mobile devices based MPSoC architectures. The ability to exploit a detailed knowledge of the system, both regarding the reference architecture and the applications field, enables the development of efficient techniques for an aggressive energy optimization. These solutions generally include several levels of abstraction and require a adequate support: from the low-level architectural design up to the level of system and application software.

The work in this research has focused on the analysis of the problem at the operating system level. The goal is to provide an adequate support in terms of system software, for a properly use of low-level hardware mechanisms according to the specific needs of the application layer. The required support is a control system that may be able to identify at runtime the optimal configuration of the platform taking into account: available mechanisms, resources and application's requirements. Depending on the specific application context, which can range from that of dedicated embedded systems (e.g., automotive controllers) to that of general purpose system (e.g., smart-phones), the possible approaches could be essentially classified as: centralized and distributed.

In the first instance the focus was on evaluation of a model for centralized control. We ported a framework, originally proposed by IBM and MontaVista Linux, to the Nomadik platform by STMicroelectronics. The same framework was then used as the base for a new proposed methodology [**C.12**] targeting the characterization of power and performance of a generic platform-based SoC. The proposed methodology allows to extract control patterns for the dynamic tuning of a system. These models can then be used by the optimization policies of the proposed framework. This activity has taken several months of work to set up a stable platform and running a set of experiments to obtain a complete and realistic energy characterization. This characterization was obtained by considering a realistic and interesting use-case. Although this approach has proven to give good results, in same time it is rather complex to implement because of the required platform pre-profiling that, even if well-automated, it is rather long to perform.

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[1] The BarbequeRTRM is public available, more information could be found on the project website: http://bosp.dei.polimi.it

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We focused also on the formulation of a distributed control model with centralized constraints. The idea comes from the relative simplicity to develop local controls and efficient centralized system for information collection. These two entities could be combined to build a hierarchical control system. The formulation of a methodology for defining control models based on an approach of this type is particularly interesting. The development of methodology [**C.8**] allowed to obtain a a simple implementation of a system for managing power and performances, based on a formal and verifiable model. It is worth noting that the proposed approach is not based on an abstract model an some simulations, but rather took into account all aspects and requirements which are necessary for its effective implementation and integration within a real operating System such as Linux. A patents [**P.1**] on the methodology has been registered by STMicroelectronics.

Multi-core scheduling for Real-Time Workloads

The use of multi-core architectures is also growing within the embedded applications, especially those dedicated to mobile multimedia applications. Accordingly, several chip manufacturers have already released, or will soon release, chips with dual cores, and it is predicted that chips with up to tens or hundreds of cores will be available within a decade. In this type of architecture is crucial appropriate use of shared resources such as caches. For example, software designs should avoid co-executing applications or threads that can worsen the performance of shared caches.

While cache-aware scheduling techniques for such platforms have been proposed for throughput-oriented applications, no such work has targeted real-time applications. This work [**C.7**] focus on real-time scheduling on multi-core architectures and especially targets the Linux operating system. We have developed and evaluated a *task_affinity* mechanism which is of simple setup from the applications standpoint and allows the RT scheduler to properly track task dependencies in order to improve caches efficiency.

WSN Modeling

The classical approaches to study and analyze the behaviors of Wireless Sensor Networks (WSN) rely on the usage of quite sophisticated and complex simulation tools. When we are interested only to evaluate the performances of a WSN, for instance in terms of throughput, delay and utilization, the usage of such kind of tools can have an excessive overhead due to their setup complexity. In these situations the availability of models based on Queuing Network (QN) theory can be sufficient to support the needs of performance analysis. However, the classical QN theory is too much limited to properly describe some fine details required to model the low-level of network protocols, for instance the Medium Access Control layer of the 802.15.4. Since, the MAC layer configuration is particularly important on defining both the performance and the energy efficiency, for example of ZigBee based networks, we are interested in models that can capture these aspects as well.

In [**R.1**] we present a model for ZigBee based WSN, which has been built using Non-Product Form Queuing Network (NPF-QN) theory. The NPF-QN is an extension of the classical QN theory providing a set of additional components that we exploited to improve the accuracy of the MAC layer description. The proposed model has been implemented and evaluated [**C.8**] using the Java Modeling Tools (JMT) suite to show its effectiveness for describing simple yet interesting sensor networks.

Patents

P.1   P. Bellasi et al. *"Power Management Using Constraints In Multi-Dimensional Parameter Space"*. US-2011/0320795-A1[2]

Publications

Books

B.1   P.Bellasi, *"Cross-Layer Framework for Constrained Power Management and Resources Optimization of Embedded Systems"*, PhD Thesis, Politecnico di Milano, 12/2009.

B.2   P. Bellasi, S. Corbetta, W. Fornaciari, *Chapter 6: "Run-time Resource Management at the Operating System level"*. Multi-objective design space exploration of multiprocessor SoC architectures: the MULTICUBE approach. Springer, 2010.

Conferences

C.1   P. Bellasi, G. Massari, W. Fornaciari. *"Exploiting Linux Control Groups for Effective Run-time Resource Management"*. 4th Workshop on Parallel Programming and Run-Time Management Techniques for Many-core Architectures (PARMA'13). Berlin, Germany, 01/2013

C.2	P. Bellasi, G. Massari, W. Fornaciari, *"A RTRM proposal for Multi/Many-Core platforms and reconfigurable applications"*. 7th International Workshop on Reconfigurable Communication-centric Systems-on-Chip (ReCoSoC'12). York, UK, 07/2012.
C.3	D. Zoni et. al, *"A Low-Overhead Heuristic for Mixed Workload Resource Partitioning in Cluster-Based Architectures"*. Conference on Architecture of Computing Systems (ARCS'12). Muenchen, Germany, 02/2012.
C.4	A. Bartzas et. al, *"Runtime Resource Management Techniques for Many-core Architectures: The 2PARMA Approach"*. International Conference on Engineering of Reconfigurable Systems and Algorithms (ERSA'11). Las Vegas, Nevada, USA, 07/2011.
C.5	C. Silvano et. al, *"Invited paper: Parallel programming and run-time resource management framework for many-core platforms: The 2PARMA approach"*. International Workshop on Reconfigurable Communication-centric Systems-on-Chip (ReCoSoC'11). Montpellier, France, 06/2011.
C.6	C. Silvano et. al, *"2PARMA: Parallel Paradigms and Run-Time Management Techniques for Many-Core Architectures"*. IEEE Computer Society Annual Symposium on VLSI (ISVLSI'10). Lixouri Kefalonia, Greece, 07/2010.
C.7	P. Bellasi, W. Betz, L. M. De Marchi, W. Fornaciari, *"A Step Toward Exploiting Task-Affinity in Multi-Core Architectures to Improve Determinism of Real-Time Streaming Applications"*. International Conference on Real-Time and Embedded Systems (RTES'10). Singapore, 11/2010.
C.8	P. Bellasi, A. Faisal, G. Serazzi, *"Queueing Network Models for Performance Evaluation of ZigBee-based WSNs"*. 7th European Performance Engineering Workshop (EPEW'10). Bertinoro, Italy, 09/2010.
C.9	P. Bellasi, W. Fornaciari, D. Siorpaes, *"Constrained Power Management: Application to a Multimedia Mobile Platform"*. Conference on Design, Automation and Test in Europe (DATE'10). Dresden, Germany, 03/2010. pp. 982-985.
C.10	P. Bellasi, S. Bosisio, M. Carnevali, W. Fornaciari, D. Siorpaes, *"CPM: A Cross-Layer Framework to Efficiently Support Distributed Resources Management"*. Workshop on Parallel Programming and Run-time Management Techniques for Many-core Architectures (PARMA'10). Hannover, Germany, 02/2010. pp. 293-298.
C.11	P. Bellasi, W. Fornaciari, D. Siorpaes, *"A Hierarchical Distributed Control for Power and Performances Optimization of Embedded Systems"*. Conference on Architecture of Computing Systems (ARCS'10). Hannover, Germany, 02/2010. pp. 37-48.
C.12	P. Bellasi, W. Fornaciari, D. Siorpaes, *"Predictive Models for Multimedia Applications Power Consumption Based on Use-Case and OS Level Analysis"*. Conference on Design, Automation and Test in Europe (DATE'09). Nice, France, 04/2009. pp. 1446-1451.
Technical Reports	
R.1	P. Bellasi, *"A MAC Layer Aware Queuing Network Model for WSN Performances Estimation"*. Politecnico di Milano. Internal report n.2009.58
R.2	P. Bellasi, *"DynamicPower for STLinux"*. Politecnico di Milano, Internal report n. 2007.76
Public Talks	
T.1	L. De Marchi, P. Bellasi, *"Multi-core Scheduling Optimizations for Soft Real-time Multi-threaded Applications – A Cooperation Aware Approach"*. Embedded Linux Conference, San Francisco - USA, 04/2010.
T.2	P. Bellasi, *"Constrained Power Management: an holistic approach to power management"*. Embedded Linux Conference in Europe, Grenoble - France, 10/2009.
Public Talks (in Italian language)	
T.3	P. Bellasi, *"Un Data-Center in Tasca: Come i Multi-Core Ci Stanno Cambiando La Vita"*. Embedded - IC & Automation Fortronic, Milano - Italy, 06/2012.

Teaching activities

AA 2011/2012	Conducting seminars and projects assistance during the course of **Embedded Systems I** and **Real-Time Operating Systems** at Politecnico di Milano (master degree in Computer Science Engineering (fifth year), given by Prof. William Fornaciari, with the title of expert on the subject.
AA 2010/2011	Conducting seminars and projects assistance during the course of **Embedded Systems I** and **Embedded Systems I** at Politecnico di Milano (master degree in Computer Science Enginering (fifth year), given by Prof. William Fornaciari, with the title of expert on the subject.

AA 2009/2010	Conducting seminars and projects assistance during the course of **Embedded Systems** at Politecnico di Milano (master degree in Computer Science Engineering (fifth year), given by Prof. William Fornaciari, with the title of expert on the subject.
AA 2008/2009	Conducting seminars and projects assistance during the course of **Embedded Systems** at Politecnico di Milano (master degree in Computer Science Engineering (fifth year), given by Prof. William Fornaciari, with the title of expert on the subject.
AA 2007/2008	Conducting seminars and projects assistance during the course of **Embedded Systems** at Politecnico di Milano (master degree in Computer Science Engineering (fifth year), given by Prof. William Fornaciari, with the title of expert on the subject.

Technical skills and competence

Operating Systems

Hacking level: Linux kernel drivers development, frameworks design and kernel base porting to HW platforms. FreeRTOS kernel porting and development.

Administration level: deep experience in Linux systems administration (Gentoo, Debian, RedHat, Suse Slackware, Mandrake, . . .) and practice with OpenBSD and FreeBSD systems.

User level: Microsoft Windows 2000-2003 Server, SunOS/Solaris, HP-Unix, Macintosh, MacOS X.

Applications Frameworks

Android: Application development and C/C++ Android internals.

Programming Languages

System programming: C (GNU/Linux), GNU/Autotools, CMake, GIT.

Object oriented programming: C++11, Boost-libs, Java.

Low level programming: Assembly (x86, ARM, and AVR).

Scripting: BASH, Python and Perl

Knowledge of: PHP, JavaScript, functional programming (LISP), SQL, XML, XSLT.

Specification languages: semi-formals (UML, WebML, W2000) and formals (Trio, Petri nets, Z).

Networking

TCP/IP Networking: Linux routing, firewalling and traffic shaping.

Configuration and administration: several network services such as DHCP, DNS, HTTP server (Apache), email (QMail and Postfix), SMB (Samba).

Security

Care for information security threats, system hardening and secure communication solutions.

Spoken languages

Italian	mother tongue.
English	good reading, writing and speaking skills.
French	school level.

Detailed Work Experiences

Open Source Projects

W.1 — ***Barbeque Run-Time Resource Manager***

Customer: Politecnico di Milano, EC funded project (FP7ICT2487162PARMA)

An highly modular and extensible runtime resource manager which provides support for an easy integration and management of multiple applications competing on the usage of one (or more) shared MIMD manycore computation devices. Details on the project website: http://bosp.dei.polimi.it

Role:

- chief developer for the framework core, integration with x86 NUMA machines and STHORM manycore platform (64 CPUs device by STMicroelectronics), Android integration, etc.
- project management, contributions review and integration
- runtime resource management policies definition for CPU bandwidth and memory allocation
- overall framework design

Code: This is an OpenSource project, mainly developed in C/C++, supported by an AOSP-like building system and tracked on BitBucket: https://bitbucket.org/bosp

W.2 **SpekMin**

Customer: Politecnico di Milano

An account activation and administration Webmin plugin for kiosk based services. This provides an integrated interface for users registration and services accounting as well as bills generation.

Role:

- verall system design and chief developer

Code: Developed using Perl, Bash, LaTeX

Linux Related Activities

W.3 **Constrained Power Management (CPM) Framework**

Customer: Politecnico di Milano - STMicroelectronics

A kernel framework, targeting power management, which permits coordination and communication between different system entities in order to grant the desired QoS by using dynamic optimization policies with a negligible impact on the system. This framework has been developed to be an extension of Linux "QoS Framework".

Role:

- principal investigator for the development of methodology which allows to obtain a simple implementation of a system for managing power and performances, based on a formal and verifiable model
- framework implementation in kernel space, testing and verification on a Nomadik NHK8815 board
- design and supervise the implementation of a corresponding user-space control daemon

Code: The code is publicly available online, the last maintained version has been rebased on 2.6.36: http://gitorious.org/linux-drk/linux-drk/commits/cpm_2.6.36

Notes:

1. This work has been sponsored by STMicroelecronics, which has filed a US Patent [**P.1**] (US 2011/0320795 A1 - "Power Management Using Constraints In Multi-Dimensional Parameter Space").
2. The framework has been presented at Embedded Linux Conference Europe (ELCE) in 2009: http://www.embeddedlinuxconference.com/elc_europe09/sessions.html#Bellasi

W.4 **Task-Affinity - A Linux SCHED_RT extension to exploit task affinities**

Customer: Politecnico di Milano - STMicroelectronics

An extension of the Linux real-time scheduling for multi-core architectures. We developed and evaluated a *task_affinity* mechanism, which is of simple setup from the applications standpoint and allows the RT scheduler to properly track task dependencies in order to improve caches efficiency.

Role:

- design and setup experiments to evaluate caches efficiencies on running stream-processing and multi-threaded multimedia applications
- study and analyze the Linux RT scheduler, looking for possible hooks to tack task affinity
- design and supervise the implementation of a task-affinity mechanism to improve caches usage for real-time multi-threaded tasks scheduling, actual implementation by Lucas De Marchi
- patches review, debugging, testing and source tree stabilization

Notes:

1. This work has been sponsored by STMicroelectronics
2. The proposed solution has been presented at Embedded Linux Conference (ELC) 2010 in San Francisco, by Lucas De Marchi, the master student I've supervised: http://www.embeddedlinuxconference.com/elc_2010/sessions.html#Marchi

W.5   *C3 - Telemetry Device for Mission Critical Automotive Market*

Customer: ENI S.p.A. - Daricom S.r.L.

Design and development of a complete HW and SW platform to support remote monitoring, tracking and control of vehicles transporting dangerous materials (e.g. fuels, chemical residuals and radioactive materials). This project has been proposed as a cooperative/competitive contest by ENI, the main italian multinational oil and gas company.

Role:

- overall SW project supervising, specifications collection and solution design
- cooperation on the development of the custom HW platform: ARM926 Atmel SoC, dual GSM, AVR based GPS and "sensors fusion" microcontroller, CAN bus interface
- Linux kernel BSP tuning for the custom board
- device drivers development for internal peripherals (e.g. ADC), companion chips (e.g. CAN controller) and external microcontroller
- ATMEL flashing utilities hacking to support the custom board layout
- u-boot hacking to support the custom board
- OpenEmbedded integration for both root-filesystem generation and custom application integrations
- firmware development for the external sensor fusion microcontroller
- C/C++ coded system telemetry application

Notes:

1. This project has been among one of the only 4 successfully implementations of the customer specifications, out of the 15+ initial companies joining the project/contest.
2. An open source version of the developed tracking and monitoring application is freely available on-line: https://github.com/derkling/CBox

U-Boot Related Activities

W.6   *UBoot for C3 Telemetry Device*

Customer: Daricom S.r.L

Hacking of uBoot to support custom design boards based on Atmel AT91SAM926 (ARM9) SoC. This project is part of [L3] experience.

Role:

- study and analyze uBoot internals
- properly configure and build eBoot for the specific board
- customized memory mappings
- added ethernet support

OpenEmbedded Related Activities

W.7   ***OpenEmbeddded for C3 Telemetry Device***

Customer: Daricom S.r.L

Hacking of OpenEmbedded to integrate a custom application and the support for custom design boards, all these based on Atmel AT91SAM926 (ARM9). This project is part of [L3] experience.

Android Projects

W.8   ***TDTrainer (still running)***

Customer: 3D Automation S.r.L.

Sports tracking Android application with advanced and personalized training profiles based on medical and physiological models.

Role:

– overall application design and development
– integration with native and proprietary
– interfacing with different medical equipments via Accessory Development Kit (ADK)
– design ADK device based on STM32F4 (ARM Cortex-M4) SoC
– ADK firmware development

Microcontrollers and Firmware

W.9   ***DerkGPS companion chip for C3 Telemtery Device***

Customer: Daricom S.r.L.

A sensors fusion companion which which is intended to collect real-time motion sensors (i.e. accelerometers, inclinometers, pressure) and GPS info to be exposed to a Linux machine based on the definition of a set of sensible events. The design has been based on an Atmel ATMega microcontroller.

Role:

– support for board design
– firmware design and development
– firmware interfacing with a Linux device driver for sensible events configuration and user-space notification

Code: A simplified and OpenSource version of the firmware is available on-line: https://github.com/derkling/DerkGPS

W.10   ***AssetTracker***

Customer: Daricom S.r.L.

A low power long life time device for assets tracking, supporting both GPS and GSM localization and data upload via SMS or data connection. The design has been based on an Atmel ATMega microcontroller.

Role:

– support for board design
– firmware design and development

W.11   ***ADControl***

Customer: Daricom S.r.L.

A 12 channels power line load monitor and remote control device, with 1[W] sensibility and up to 800[W] load per channel, targeting "smart traffic light" system. The design has been based on an Atmel ATMega microcontroller and the OpenSource BeRTOS Real-Time OS, a GSM connection for data uploading as well as an SMS based query, notification and configuration protocol.

Role:

  – support for board design
  – firmware design and development

Code: A simplified and OpenSource version of the firmware is available on-line: https://github.com/derkling/adcontrol.

Last update: March 25, 2013

Kind regards,
Patrick Bellasi

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