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Editorial

Challenges on Complexity and Connectivity in Embedded Systems

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Technology advances and a growing field of applications have been a constant driving factor for embedded systems over the past years. However, the increasing complexity of embedded systems and the emerging trend to interconnections between them lead to new challenges. Intelligent solutions are necessary to solve these challenges and to provide reliable and secure systems to the customer under a strict time and financial budget.

Typically, intelligent solutions often come up with an orthogonal and interdisciplinary approach in contrast to traditional ways of engineering solutions. Many possible intelligent methods for embedded systems are biologically inspired, such as neural networks and genetic algorithms. Multiagent systems are also prospective for an application for nontime critical services of embedded systems. Another field is soft computing which allows a sophisticated modeling and processing of imprecise (sensory) data.

Thus, as expected, we received a variety of papers with interesting solutions within the topic of the special issue. We hope that this special issue will be as inspiring as it was for the editorial team.

In This Issue. The articles in this special issue cover several aspects of intelligent solutions for embedded systems. We have identified three major topics that are applications, platforms, and tools as well as aspects of theory and fundamental concepts. The following eight articles are included in this special issue.

Traction Control System for Motorcycles. Conti et al. describe a solution for traction control for motocross and supermotard motorcycles. Traction control systems for four-wheel vehicles and some heavy road motorcycles are widely used, but not for small motorcycles. The authors present an algorithm and a low-cost real-time hardware implementation as a prototype.

Evaluation of a "Smart" Pedestrian Counting System Based on Echo State Network. In this article, Mathews and Poigné present a pedestrian counting system using distributed sensing. According to its performance, the system is a better alternative to existing low-cost pedestrian counting systems. The motion pattern is recorded using a set of passive infrared (PIR) sensors. Attached to these, a wireless sensor node processes the data and transmits it to a base station. There a recurrent neural network called Echo State Network predicts the pedestrian count from the input patterns.

Differential Bearing Estimation for RF Tags. Localization and tracking using wireless communication have been an active research area, yet a universal solution has not emerged so far. Ledeczi et al. present a novel method for bearing estimation based on a rotating antenna generating a Doppler-shifted RF signal. The small frequency change can be measured even on low-cost resource constrained nodes using a radio interferometric technique. With a few such measurements a node can be accurately localized.

An Embedded Software Platform for Distributed Automotive Environment Management. Vehicle platforms become more and more extended by features for driving safety. Additions are usually dedicated sensor systems, which are hardly extensible or scalable. As a possible solution Seepold et al. propose an embedded OSGi-based UPnP platform in order

to manage the vehicle components heterogeneity and to provide a plug and play support. The proposed approach is expected to ease setup, service provisioning, and enable connections to external and remote network services.

Time-Predictable Computer Architecture. Today's general purpose processors have been optimized towards maximum throughput, using features like pipelines with instruction dependencies, caches, branch prediction, and out-of-order execution. However, these features make it very difficult to perform a safe and tight worst-case execution time (WCET) analysis of programs running on such a processor. In this article Schoeberl describes the concepts for a time-predictable computer architecture. As a case study, the concepts are evaluated in a Java-optimized processor.

Microcontroller Based Process Monitoring Using Petri-Nets. Petri-nets have been previously largely used in the areas of systems modelling and simulation. In this article Prickett et al. employ this concept as a process monitoring and management application. The monitoring system can be deployed on an embedded microcontroller, thus depicting a small implementation footprint for presented framework.

Towards Preserving Model Coverage and Structural Code Coverage. Embedded systems, especially when used in safety-critical applications require a thorough testing with good coverage of the code. However, due to compiler optimizations, the code coverage achieved at machine code level might not be given even though the test case cover the high-level program representation well. In this article Kirner addresses this problem, and discusses methods for preserving code coverage achieved at source-code level and introduce a notation for formalizing structural code-coverage. These notations also serve to express testdata independent criteria for preserving the code coverage. Thus, it can be proven if given program transformation does always preserve the structural code coverage of interest or not.

Firefly Clock Synchronization in an 802.15.4 Wireless Network. The Firefly synchronization approach is a bioinspired synchronization method which is totally distributed, robust against erroneous nodes, and simple to implement. In this article, the Leidenfrost and Elmenreich present an adaptation of the Firefly algorithm for a wireless network. The used reach-back modification of the original approach is analyzed and explained. A case study implemented on 802.15.4 Zigbee scheduling and coordinated duty cycling in order to enhance the battery lifetime of the nodes.

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