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Special Issue

Special Purpose Architectures for Real-Time Imaging

Real-time imaging systems are gaining in importance in many fields ranging from multimedia, to robotics, to visual inspection in production plants, to critical safety systems, to vision in satellite and military applications. The specific requirements, such as processing power, physical size, power consumption cannot always be provided by general purpose processor systems and special purpose architectures are developed to overcome these limits.

Architectures can be customized at different levels. At the first level is a design of a special-purpose system by the employment of available blocks, such as Digital Signal Processors (DSPs), programmable devices, multiple port memories, which are integrated into an innovative architectural solution. A more complex level is the customization of the architecture down to the IC level, which in general offers higher performances and lower power consumption and size. The investments for a special purpose solution are high since specialized know-how and equipment are required. In particular this is true for architectures based on custom-integrated circuits for which prototyping costs and times are critical points. Also, the cost of the final product may be high when the production figures are low.

A common objection to the development of special-purpose architectures is that such high development costs and long design times may not be justified by the average lifetime of the product. This is because the performance increase of general purpose processors, associated with a fast technological evolution and motivated by large production figures, may make a special-purpose solution obsolete in a short time.

This risk exists and can be avoided only by a careful comparative evaluation of both approaches combined with a reasonable forecast of the technological evolution. This is a rather complex task especially considering real-time constraints and may require detailed analysis.

On the other hand, when time-to-market constraints or other application requirements are such that a solution must be provided in a very short time, thus using only currently available technology, then a special-purpose system is mandatory.

It should be observed that a special purpose solution may allow reduced clock frequency and lower power consumption since extremely high performances can be obtained by the optimal match between the problem to be solved and the architectural solution. As a result, higher system reliability and efficiency may be achieved.

Moreover, from a research point of view, the development of special purpose systems is a test-bed for the experimentation of solutions to be embedded in future general-purpose systems. As an example, current special systems for multimedia applications, available as separate boards in todays personal computers (such as MPEG encoding/decoding plug-in boards), are likely to be directly integrated in future processors.

As the development of special-purpose systems is aimed at the solution of specific tasks, the strong match between the applications requirements and the *ad hoc* hardware solutions does not allow us to define a general performance index for different architectures and to classify them is a strict taxonomy.

The great interest in the field has been demonstrated by

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the large number of submissions from academia, industry, and government institutions.

The main aim of this special issue is to present the leading state-of-the-art systems where the hardware architecture strictly matches the application characteristics. Since the quality of the submissions was particularly high it was decided to publish them in several *Real-Time Imaging* Issues.

The first one comprises six contributions on different aspects of real-time vision architectures. The first paper by Fernàndez *et al*., presents a parallel and pipelined architecture for MPEG coding; Charles Weems presents some considerations on the well-known image understanding architecture. Arias-Estrada *et al*. describe an architecture for motion computation which also includes a direct interface to the acquisition sensor. Valle *et al*. present a VLSI architecture used for quality control in an industrial environment, while Plaks describes a system that allows a fast execution of template matching. Finally, the paper by Houzet presents the architecture of a scalable MIMD system and its programming environment.

Future issues of the special issue will focus on other topics of vision architectures covering design, implementation, theoretical ideas and applications.

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