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(Article I)

Several Paths to Longer Battery Life

The boom in mobile devices and data centers has circuit designers racing to find new ways to slash power consumption. At this year's International Solid-State Circuits Conference, in San Francisco, several power-saving technologies took center stage. Some will emerge in products this year, while others are just beginning to catch the interest of major chipmakers.

NEAR-THRESHOLD COMPUTING

Academics have long toyed with the idea of operating chips at a point very close to the threshold voltage—the amount needed to switch a transistor on. Now the scheme seems to be getting picked up by industry. Intel researchers discussed a 32-nanometer, Pentium-class chip they've built that can operate from 1.2 volts—de rigueur for today's processors—all the way down to 280 millivolts. The chip's sweet spot for energy efficiency was 450 mV, just above the threshold voltage. At that level, Intel's chip ran slowly, at less than 100 megahertz, but it also consumed just about a fifth of the energy it did at 1.2 V. Parallel processing could be used to pick up some of the slack in performance.

RAZOR-THIN MARGINS

Engineers typically run chips at a higher voltage than needed in order to prevent clocking errors. If chips had a way to detect errors and change their operating voltage on the fly, engineers could push chips to operate at the lowest voltage possible, saving power in the process. The scheme, called Razor, is still largely stuck in academic circles. But researchers from the University of Michigan, in Ann Arbor, and Harvey Mudd College, in Claremont, Calif., showed that the approach works on an ARM Cortex-M3 processor, boosting energy efficiency by 60 percent. The team says it's the first implementation of a Razor-style scheme on a complete commercial processor.

SMALLER TRANSISTORS

Intel has packed 1.4 billion 3-D transistors onto Ivy Bridge, its next-generation processor. The switch to less leaky 3-D transistors has given the new chip a big power boost. The 22-nm Ivy Bridge chips can be run just as fast as the company's previous chips, but with an operating voltage that's 200 mV lower. Intel has also incorporated designs at the circuit and core level to improve the chip's power management. A separate system-on-a-chip code-named Silvermont, based on the same transistor-making process, will be geared for mobile handsets.

(Article II)

Internet of Things

The Internet of Things (IoT) is a novel paradigm that is rapidly gaining ground in the scenario of modern wireless 40 telecommunications. The basic idea of this concept is the pervasive presence around us of a variety of things or objects – such as Radio-Frequency IDentification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbors to reach common goals.

Unquestionably, the main strength of the IoT idea is the high impact it will have on several aspects of everyday-life and behavior of potential users. From the point of view of a private user, the most obvious effects of the IoT introduction will be visible in both working and domestic fields. In this context, domotics, assisted living, e-health, enhanced learning are only a few examples of possible application scenarios in which the new paradigm will play a leading role in the near future. Similarly, from the perspective of business users, the most apparent consequences will be equally visible in fields such as, automation and industrial manufacturing, logistics, business/process management, intelligent transportation of people and goods.

This survey gives a picture of the current state of the art on the IoT. More specifically, it:

- provides the readers with a description of the different visions of the Internet of Things paradigm coming from different scientific communities;
- reviews the enabling technologies and illustrates which are the major benefits of spread of this paradigm in everyday-life;
- offers an analysis of the major research issues the scientific community still has to face.

(Article III)

Natural Convection Flow in A Square Cavity

Natural convection in a square cavity has been analyzed numerically using a control volume approach. Calculations have been performed for both laminar and turbulent flow (κ-ε model) with and without logarithmic wall functions for a series of ***Ra*** up to 10^{10}. Accurate results have been obtained regarding grid independence. The solution captures very well all flow and heat transfer phenomena, especially near the walls where dense, non-uniform grids are used in the thin boundary layers formed there.

The present results compare favorably with benchmark solutions [6] for the laminar case and similar calculation [20, 22, and 23] for the turbulent case. Correlations between ***Nu*** and ***Ra*** are also in agreement with similar ones found in the literature [20, 22]. The turbulent solution has a laminar approximation with a non-zero turbulent viscosity for low values of *Ra* ($< 10^6$). This solution is followed by a turbulent one for ***Ra*** greater than 10^6 when logarithmic wall functions are used or 10^8 when log-functions are used only for κ and ε. The mean ***Nu*** along the hot wall shows a sudden increase when the turbulent solution is reached.

Comparisons of the simulation results have also been made with some experimental data for the primary variables and ***Nu-Ra*** correlations [17, 23]. Although it is clear that more experimental data are needed for a comparison based on primary variables, it turns out that the standard κ-ε model has limitations in predicting the mean ***Nu*** along the hot wall of the cavity.

Apart from the turbulence model, the use of logarithmic wall functions for the temperature and velocity leads to significant over predictions for ***Nu.*** Since the most important phenomena occur near the cavity walls while the core remains stratified, such an influence is expected. Logarithmic wall functions have been proved inaccurate for predicting heat transfer in natural convection, since by dropping them, a much more reasonable prediction for the heat transfer is obtained. Therefore new types of wall functions such as the power-law ones suggested by George and Capp [11] for the velocity and temperature in combination with modified versions of the κ-ε model for low-Reynolds-number flows must be checked.