

DISTINGUISHED LECTURE

Center for Embedded Computer Systems

Presents

Real-Time Dynamic Voltage Scaling for Low-Power Embedded Operating Systems

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Abstract

In recent years, there has been a rapid and wide spread of non-traditional computing platforms, especially mobile and portable computing devices. As applications become increasingly sophisticated and processing power increases, the most serious limitation on these devices is the available battery life. Dynamic Voltage Scaling (DVS) has been a key technique in exploiting the hardware characteristics of processors to reduce energy dissipation by lowering the supply voltage and operating frequency. The DVS algorithms are shown to be able to make dramatic energy savings while providing the necessary peak computation power in general-purpose systems. However, for a large class of applications in embedded real-time systems like cellular phones and camcorders, the variable operating frequency interferes with their deadline guarantee mechanisms, and DVS in this context, despite its growing importance, is largely overlooked/under-developed. To provide real-time guarantees, DVS must consider deadlines and periodicity of real-time tasks, requiring integration with the real-time scheduler. In this talk, we present a class of novel algorithms called the real-time DVS (RT-DVS) that modify the OS's real-time scheduler and task management service to provide significant energy savings while maintaining real-time deadline guarantees. We show through simulations and a working prototype implementation that these RT-DVS algorithms closely approach the theoretical lower bound on energy consumption, and can easily reduce energy consumption 20% to 40% in an embedded real-time system.

This is joint work with Padmanabhan Pillai.

Biography

Kang G. Shin is the Kevin and Nancy O'Connor Professor of Computer Science and Founding Director of the Real-Time Computing Laboratory in the Department of Electrical Engineering and Computer Science, The University of Michigan, Ann Arbor, Michigan. His current research focuses on QoS-sensitive networking and computing as well as on embedded real-time OS, middleware and applications, all with emphasis on timeliness and dependability. He has supervised the completion of 42 PhD theses, and authored/coauthored over 500 technical papers and numerous book chapters in the areas of distributed real-time computing and control, computer networking, fault-tolerant computing, and intelligent manufacturing. He has co-authored (jointly with C. M. Krishna) a textbook "Real-Time Systems," McGraw Hill, 1997. He received the Outstanding IEEE Transactions on Automatic Control Paper Award in 1987, Research Excellence Award in 1989, Outstanding Achievement Award in 1999, Service Excellence Award in 2000, and Distinguished Faculty Achievement Award in 2001 from The University of Michigan. He also received a Distinguished Alumni Award from the College of Engineering, Seoul National University in 2002, and the IEEE Communications Society William R. Bennett Prize Paper Award in 2003. He has also coauthored papers with his students which received the Best Student Paper Awards from the 1996 IEEE Real-Time Technology and Application Symposium, and the 2000 UNSENIX Technical Conference. He received the B.S. degree in Electronics Engineering from Seoul National University, Seoul, Korea in 1970, and both the M.S. and Ph.D. degrees in Electrical Engineering from Cornell University, Ithaca, New York in 1976 and 1978, respectively. From 1978 to 1982 he was on the faculty of Rensselaer Polytechnic Institute, Troy, New York. He has held visiting positions at the U.S. Airforce Flight Dynamics Laboratory, AT&T Bell Laboratories, Computer Science Division within the Department of Electrical Engineering and Computer Science at UC Berkeley, and International Computer Science Institute, Berkeley, CA, IBM T. J. Watson Research Center, Software Engineering Institute at Carnegie Mellon University, and HP Research Laboratories. He also chaired the Computer Science and Engineering Division, EECS Department, The University of Michigan for three years beginning January 1991.

He is Fellow of IEEE and ACM, and member of the Korean Academy of Engineering, was the General Chair of the 2000 IEEE Real-Time Technology and Applications Symposium, the Program Chair of the 1986 IEEE Real-Time Systems Symposium (RTSS), the General Chair of the 1987 RTSS, the Guest Editor of the 1987 August special issue of *IEEE Transactions on Computers* on Real-Time Systems, a Program Co-Chair for the 1992 *International Conference on Parallel Processing*, and served numerous technical program committees. He also chaired the IEEE Technical Committee on Real-Time Systems during 1991-93, was a Distinguished Visitor of the Computer Society of the IEEE, an Editor of *IEEE Trans. on Parallel and Distributed Computing*, and an Area Editor of *International Journal of Time-Critical Computing Systems*, *Computer Networks*, and *ACM Transactions on Embedded Systems*.

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Refreshments at 1:30pm, Lecture begins at 2:00pm

McDonnell Douglas Auditorium

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