Tutorial T7-B

Power Management for Mobile Multimedia: From Audio to Video and Games

Samarjit Chakraborty, National Univ. of Singapore, Singapore, samarjit@comp.nus.edu.sg
Ye Wang, National Univ. of Singapore, Singapore, wangye@comp.nus.edu.sg

Abstract

Multimedia applications today constitute a sizeable workload that needs to be supported by a host of mobile devices ranging from cell phones, to PDAs and portable game consoles. Battery life is a major design concern for all of these devices. Whereas both – the complexity of multimedia applications and the hardware architecture of these devices – have progressed at a phenomenal rate over the last one decade, progress in the area of battery technology has been relatively stagnant. As a result, currently a lot of effort is being spent to develop high-level power management and application tuning techniques to minimize energy consumption and thereby prolong battery life. Such techniques include dynamically scaling the underlying processor’s voltage and clock frequency in response to a time-varying workload, powering down certain system components when not being frequently used, and backlight scaling in LCDs with controlled image-quality degradation. Some of the application tuning techniques include selectively ignoring certain perceptually-irrelevant computations during audio decoding, and injecting metadata with workload information into video clips which can then be used to accurately estimate the decoding workload at runtime for better power management.

In this tutorial, we plan to give a comprehensive overview of this area and discuss power management schemes for a broad spectrum of multimedia applications. In particular, we will talk about several power management and application tuning techniques specifically directed towards audio decoding, video processing and interactive 3-D game applications. Starting from the basics of power management for portable devices, we will discuss the necessary mathematical techniques, give high-level overviews of relevant algorithms and also present the hardware setup that is necessary to perform research and development in this area.

The main objective of this tutorial will be to cover various techniques for power management for audio, video and graphics-intensive game applications running on battery-operated portable devices. In particular, we would illustrate how power management techniques differ for audio, video and game applications and would present a number of techniques for each of these classes of applications. We would also give an overview of open research problems and the challenges facing this area. Finally, we would describe some of the hardware platforms that we have been using to conduct research in this domain and give demonstrations of selected power management techniques.

Speaker Biographies

Samarjit Chakraborty is an Assistant Professor of Computer Science at the National University of Singapore. He obtained his Ph.D. in Electrical and Computer Engineering from ETH Zurich in 2003. For his Ph.D. thesis, he received the ETH Medal and the European Design and Automation Association’s “Outstanding Doctoral Dissertation Award” in 2004. His work has also received Best Paper Award nominations at DAC 2005, CODES+ISSS 2006 and ECRTS 2007, all of which are premier conferences in the real-time/embedded systems area. Samarjit’s research interests are primarily in system-level power/performance analysis of embedded systems. He has extensively...
published in major research forums on this topic including DAC, DATE, CODES+ISSS, ASP-DAC, RTSS and RTAS, and regularly serves on the technical program committees of many of these conferences. Over the last few years he has been working on various problems specifically related to power management of multimedia applications and have co-authored several papers and patents in this area. He has given invited talks on various topics related to design, modeling and analysis of embedded systems at various universities and industrial labs, including UC Berkeley, MIT, CMU, Philips, General Motors and Creative Technology Labs. His experience with conducting tutorials include (i) a tutorial at the IEEE International Conference on Multimedia & Expo (ICME) at Amsterdam in July 2005, entitled “Multimedia Processing on Multiprocessor SoC Platforms: What should Multimedia System Developers know about Architectural Design, Performance Analysis and Platform Management?” (jointly with Radu Marculescu from CMU and Paul Stravers from Philips Research), (ii) a half-day solo tutorial at the ACM Multimedia Conference (MM) at Santa Barbara in October 2006 on “Flexible Modelling and Performance Debugging of Real-Time Embedded Multimedia Systems”, (iii) a tutorial at the VLSI Design Conference at Bangalore in January 2007 on “Performance Debugging of Complex Embedded Systems” (jointly with Abhik Roychoudhury from NUS), (iv) a tutorial at the ARTIST2 Winter School on Modelling, Testing, and Verification for Embedded Systems (MOTIVES) at Trento, Italy in February 2007 on “Interactive Performance Debugging of Real-Time Systems”, (v) tutorial at the VLSI Design Conference at Hyderabad in January 2008 on “Programming and Performance Modelling of Automotive ECU Networks” (with S. Ramesh, General Motors R&D - India Science Lab), and (vi) a tutorial at the Design, Automation and Test in Europe Conference (DATE) at Munich in March 2008 on “Formal Methods in System and MpSoC Performance Analysis and Optimisation” (with Rolf Ernst from TU Braunschweig, Kai Richter from Symtavision, Hans Sarnowski from BMW, and Marco Bekooij from NXP).

Ye Wang received his Dr.-Tech. degree from the Department of Information Technology, Tampere University of Technology, Finland. In 2001, he spent a research term at the University of Cambridge, U.K., working with Prof. Brian Moore on compressed domain audio processing. He is currently an Assistant Professor with the Department of Computer Science, School of Computing, National University of Singapore. Dr. Wang has had a nine-year career with Nokia Research Center in Finland as research engineer and senior research engineer, where he worked on Digital Audio Broadcasting (DAB) receiver prototype development, optimization of perceptual audio coding algorithms, error resilient audio content delivery to mobile phones and compressed domain audio processing for multimedia applications on small devices. His research interests include audio compression and content-based processing, perception-aware and low-power audio processing, and error resilient content delivery to handheld devices via wireless networks. He holds a dozen patents in these areas and has published about 30 international journal and conference papers. He is a member of the technical committee, Coding of Audio Signals of the Audio Engineering Society; and a member of the Multimedia Communications Technical Committee, IEEE Communications Society. Dr Wang has also given a number of tutorials and courses on audio and video processing while at Nokia Research Center Finland and regularly teaches these topics at the National University of Singapore.