

INTEGRATING CONCEPTS AND PRACTICE IN TEACHING EMBEDDED SYSTEMS DESIGN

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SUMMARY

Effectively teaching Embedded Systems usually becomes an interesting challenge for instructors. In a typical course, students should be exposed to the right blend of hardware and software design concepts, successfully apply them to complete some sort of design project, and achieve some level of implementation of their designs. The fact that implementation requires laboratory work, invariably involving debugging the hardware and software components of their designs on an off-the-shelf embedded microprocessor does not make the task any easier. Within this process, the architecture and features of the target device as well as the capabilities and easiness of use of development tools play a central role in the overall teaching/learning experience.

This paper describes the use of Texas Instruments' MSP430 family of ultra low-power microcontrollers to teach embedded systems design at the Electrical and Computer Engineering Department in the University of Puerto Rico at Mayagüez. The target audience in this teaching experience included undergraduate level students from within the department programs in electrical and computer engineering taking the Microprocessor Interfacing course. This course has been structured to provide a major design experience to students in both programs.

This article reviews general aspects of the MSP430 devices that support the decision of adopting them as part of the target devices used in the course. The selection criteria included considerations such as learning curve, availability, and ease of use of tools for assembly and high-level language programming and debugging, portability issues between different family models, and easiness in the interfacing procedures.

Details on the course organization and covered topics provide insight into the teaching strategy followed throughout the semester. The impact of using the indicated microcontroller is quantified through the project outcomes. Descriptions of typical projects completed in the class are included, highlighting the student learning experience at the hardware and software levels and their system integration. These descriptions also provide insight into the way in which students deal with design tradeoffs affecting issues such as the economical, environmental, ethical, political, social, health and safety, manufacturability, and sustainability aspects of their projects. The learning experience is evaluated through exit surveys and student performance observations throughout the semester long project. Both formative and summative tools are used to assess the students' learning experience and the particular impact of using the MSP-430 devices and tools in their projects.

CONFERENCE SCHEDULE SUMMARY

The use of a family of low-power microcontrollers to teach embedded systems design to EE and CE students is presented. A review of aspects in the processor family is presented to support their selection as part of the target devices used in the course. Course organization details and topics provide insight into the teaching strategy. The impact of using the indicated microcontroller on the students' learning process is quantified through project outcomes, surveys, and performance observations.