Multifunctional digital embedded platform

Philip Van Pelt, Patrick Pelgrims, Tom Tierens, Wim Dams, Bjorn Van de Vondel
Hogeschool voor Wetenschap & Kunst, campus [De Nayer Instituut]
Associated partner of K.U.Leuven
J. De Nayerlaan 5, 2860 Sint-Katelijne-Waver, Belgium
email: { pvp, ppe, tti, wda }@denayer.wenk.be, bjorn.vandevondel@dspvalley.com

Abstract

An integrated development board with several different technologies can be useful in many areas. Especially in education, these platforms can have huge advantages. Both course-specific practical courses and interdisciplinary courses can benefit from it. The “De Nayer Instituut”, an associated partner of the K.U. Leuven located in Sint-Katelijne-Waver (Belgium), in cooperation with IWT and some industrial partners, developed such a system. It consists out of two boards: an engine-board with processing units and a base-board containing several interfaces. This paper describes the implementation of a multifunctional digital embedded camera platform currently used in education.

1 Introduction

Many manufacturers provide developing boards for their products. These are, at first sight, great for course-specific practical sessions, although several obvious issues must be kept in mind; cost, availability, manufacturer, compatibility, documentation, ... But there are also less obvious aspects to consider. Can the boards be used in different courses and thus reducing hardware costs? Are the boards general enough to be used in an interdisciplinary way? What is the time needed to start developing with such a platform?

Figure 1. Processing board

After an analysis of the different embedded courses, the conclusion was made that the ‘ideal’ platform should contain an interconnected general processing unit, a DSP unit and an FPGA. This way different functions can be implemented on the same board. Secondly students must be able to create their own low-cost interface. The emsys research group [1] decided to build such a board themselves. The result is a multifunctional embedded platform.

2 Board overview

The platform described in this paper consists out of two boards: the engine board containing all the processing units and a base board that contains all interfaces. The generic interconnection between the two boards provides the future possibility to change either the base or the processing board. The base board contains the power supply, debug functionality and a CMOS image sensor. By changing the baseboard, new functionality can be provided. This reusability of hardware makes sure the platform can be deployed in many different areas of electronics.

The engine board (Fig.1) contains three different processing units, each capable to run standalone. This ensures that the platform can be used in several courses each focusing on a different aspect or technology. On the other hand, they are also interconnected, allowing a more multidisciplinary approach.

Each processing unit will be discussed briefly in the next paragraphs. First mentioned is the general processing, followed by digital reconfigurable logic. The third section describes the digital signal processing part.

3 General processing

The first component on the processing board (Fig.2) is an Intel PXA255 [2] general purpose embedded processor (GPU). The RAM and Flash memories provide enough storage for the processor to boot and work standalone. Several Input-Output pins and interconnections (USB, audio, ADC, RS232, Ethernet) available on this component are mapped
onto the high-speed connectors to the base-board. The PXA255 runs on Linux 2.6 including all the necessary drivers to control the peripheral hardware. Several other operating systems, like Windows CE and eCos (a real-time operating system) were already ported to the platform, but in these cases not all peripherals are supported.

SDRAM and Flash memory. This should be more than enough to handle most types of signal processing. The DSP is also able to run uCLinux with partial support for the different peripherals.

6 Integration in education
All documentation, both hardware and software, will be released as open source. In the near future a wiki-website will be available to support the platform. The manufacturing cost is deliberately kept as low as possible to insure easy access to the hardware for both universities and students. As every processing unit can run independently of the other, the board can be used in courses focusing on several individual topics. Furthermore the interconnections between those units give the possibility to integrate the different courses more tightly. Bigger interdisciplinary projects will teach students to cooperate, let them discuss and implement protocols and give them the possibility to experiment with different solutions for the same problem. This will certainly stimulate students to spend more time working on their projects and gaining experience in electronics. By designing custom extensions, the students are able to expand the current platform and even use it as a base for home projects.

7 Conclusion
The use of a multifunctional platform in education can have many benefits ranging from reduced overall cost to increased student interest. When a lack of knowledge or time prevents universities from developing such a system, cooperation with other universities can help reduce development costs. On the other hand, the experience gained by developing your own platform will certainly make up for the time or money spent on the project.

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References