財團法人國家實驗研究院
國家晶片系統設計中心

National Chip Implementation Center
National Applied Research Laboratories

Case Study:
A Universal Study Platform for
Embedded Software Education

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Outline

- Introduction
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  - CIC National Project
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  - A Sample Case from Three Domestic Platforms
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INTRODUCTION

Abstract

- This paper presents the study of experience to promote ESW (Embedded Software) education in Taiwan.

- The case is a national project carried out by CIC.
  - The Universal Study Platform
  - Introduction of three domestic hardware platforms in Taiwan

- The project has great achievements, and students' feedbacks showed the suitability of domestic hardware platforms for ESW educations.

Introduction

- The importance of embedded systems in industry.

  - Nearly 50% of the 100 biggest companies in Europe have invested in embedded systems research. (in 2009 ICT Results)

- Increasing requirements of the talents of embedded systems.

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Introduction

- To promote ESW education, a national project is carried out by CIC.
  - Cultivation of IC design manpower and promotion of IC design technology.
  - Promotion of ESW Education
  - An universal study platform that shares resources for ESW education.

- Under the support of Taiwan government, several platforms have been developed by Sunplus, ANDES, and ITRI in Taiwan.

IC (1994) → SoC (2006) → ESW (2007)

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Introduction

- There is lots of vendors offering different embedded system solutions in different architectures.

- In ESW design courses, students usually need to learn ESW programming using different hardware kits for various applications.

- Problems
  - Software resources of different platforms are dispersive or not public.
 - The specification of every platform is different.

CASE STUDY

Achievements of the Project

- ## Providing Hardware Kits to Universities in Taiwan

  - Nearly 300 platforms were provided for projects or courses in universities.

  - Assisting universities in establishing developing environments.

  - Establishing an web-based platform for learning ESW design.

Delivered Hardware Kits

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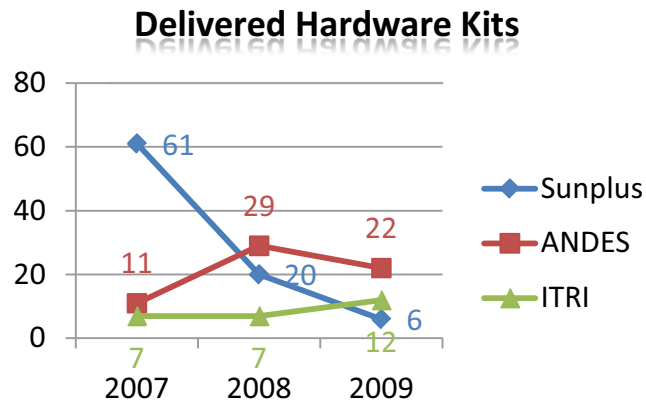
Achievements of the Project

- Establishing Design Samples and Providing Design Databases for Queries from Teachers or Students
  - An universal study platform that providing design resources sharing, suggestion of learning level, virtual classroom, and Q&A is established.

- Providing Training Courses and Conferences
  - 20 short training courses are delivered for about 500 students each year.

Provided ESW Related Courses

(2007: 9, 2008: 15, 2009: 14)
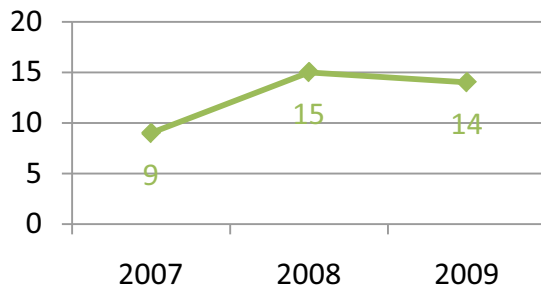
Attended Students (ESW Courses)

(2007: 405, 2008: 546, 2009: 440)

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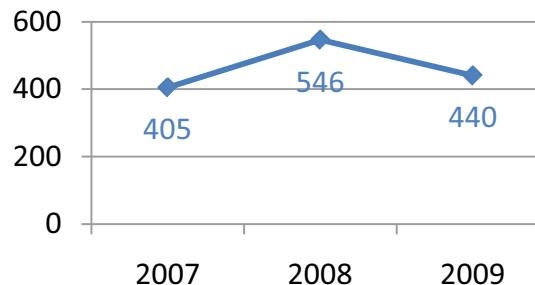
Achievements of the Project

- Holding Design Contests
  - A national ESW design contest was held.
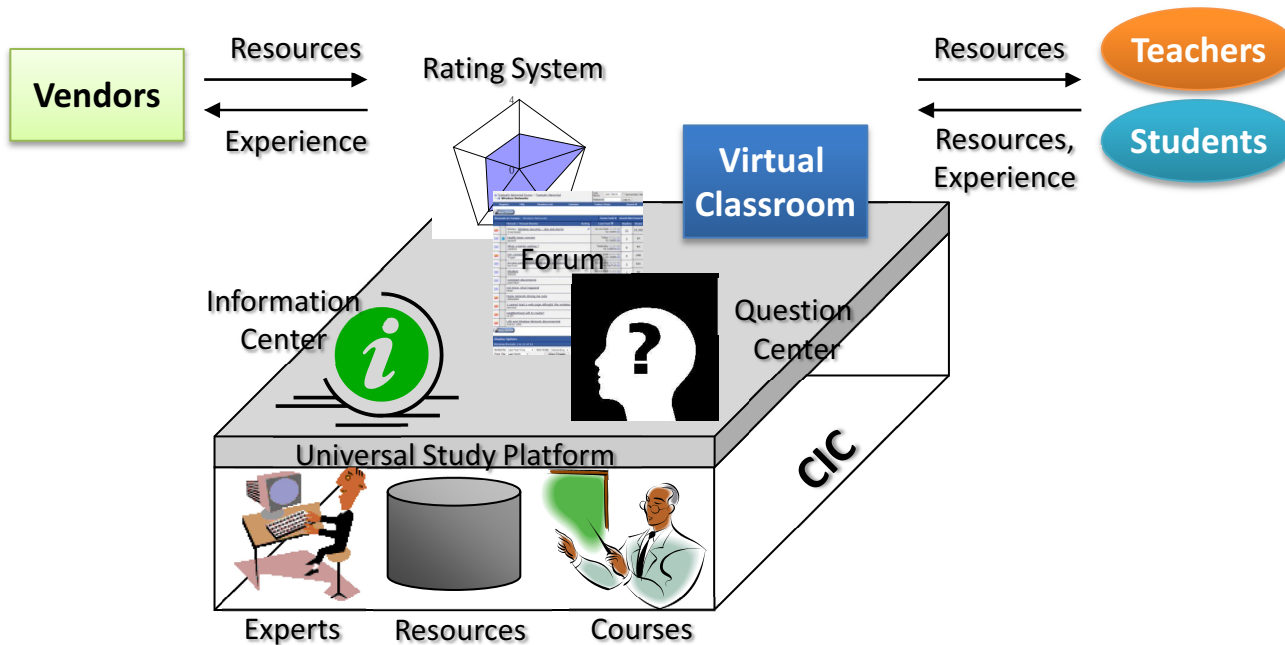 - An international DSP & ESW design contest is held every year.

2010 IC Design Contest (2010 Apr. 28 ~ 30 in CIC)

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The Universal Study Platform

- The universal study platform can be viewed as an unified window between learners, vendors, and CIC to learn hardware platforms.

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The Universal Study Platform

- A centralized database that collected dispersed resources together.
  - Collections of documents and design samples of all hardware kits.
  - Source from manufacturers, CIC, students, and the Internet.
- A forum to share experience and feedback.
  - User Feedback
  - Discussion of Learning Experience
  - Sharing of Design Samples and Design Ideas

The Universal Study Platform

- An open rating system of hardware platforms.
  - Suggestion of the learning level of every hardware platform
- A virtual classroom and laboratory for students.
  - Online Courses
  - Virtual Lab
- Q&A Service
 - Problem Queries of Hardware Kits

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Learning Indices

- The factors that benefit students to learn a hardware platform.

- The Universal Platform suggests learning indices for reference according to some criteria.

- A student can select a suitable platform corresponding to his requirements and degree according to the learning indices.
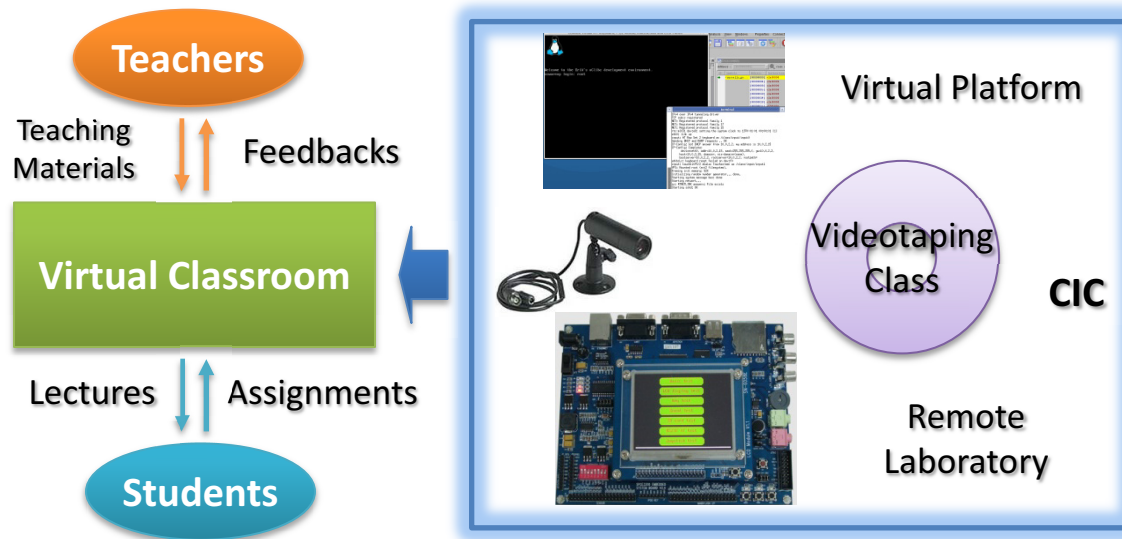
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Criteria of Learning Level

- Degree of Transparency

- Number of Design Samples

- BSP (Board Support Package)

- User Rating

- Others
  - ISA (Instruction Set Architecture)
  - Peripherals
  - Hardware Components

Factor 1   Factor 6

Factor 2   Factor 5

Factor 3   Factor 3

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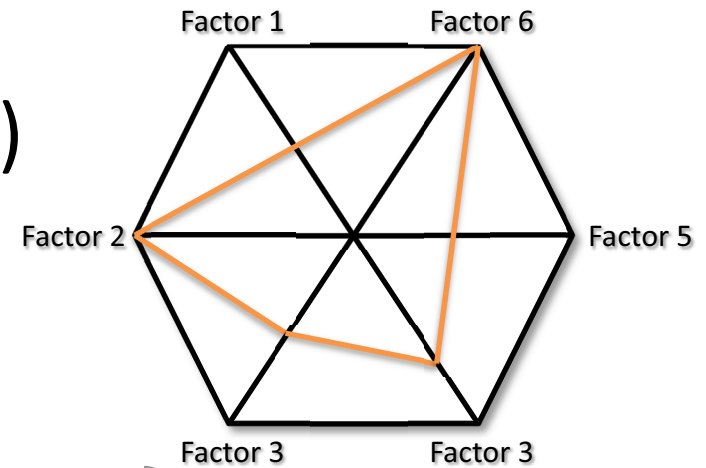
Virtual Classroom

- Online Courses
  - Video Clips
  - Handouts

- Virtual Laboratory
  - Virtual Platform for Students to Practice

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Three Domestic Platforms

LEARNING EXPERIENCES

Features of the Domestic Platforms

Platform	Learning Level	Features
SUNPLUS	Low	16/32-bit Mixable ISA
		Rich Peripherals
		MPEG-4/JPEG Hardware Accelerator
ANDES TECHNOLOGY	Medium	16/32-bit Mixable ISA
		High Speed Micro Processing Unit
		Comprehensive Integrated Development Environment
		Full-Integrated All-Around Emulator
		Large Memory Size
工業技術研究院 Industrial Technology Research Institute	High	MPU + DSP (Heterogeneous Dual-Core)
		Dynamic Voltage and Frequency Scaling Unit (DVFS)
		H.264 Hardware Accelerator

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Applicable Cases of the Domestic Platforms

| Platform	Applicable Cases
SUNPLUS	Low-Power Device, Controller
	Sensor, Robot
	Small Household Appliance, Game Console
ANDES TECHNOLOGY	High-Complexity Computation or Analysis
	Netbook, Mini Computer, E-Book
	Surveillance Computer
工業技術研究院 Industrial Technology Research Institute	Multi-Task Processing
	Real-Time Multimedia Coding
	Power Management
	PDA, Smart Phone, DVR

Key Learning Areas of the Domestic Platforms

Platform	Key Learning Areas
SUNPLUS	Peripheral Controlling Programming
	Non-OS Device Driver Programming
	Peripheral Controlling
ANDES TECHNOLOGY	OS Kernel Programming
	General-Purpose OS Programming
	Proposed Platform Prototyping
工業技術研究院 Industrial Technology Research Institute	Digital Signal Processing
	Multi-Thread Programming
	Hardware Accelerator Controlling

Learning Indices of Sunplus SPCE3200

Sunplus SPCE3200
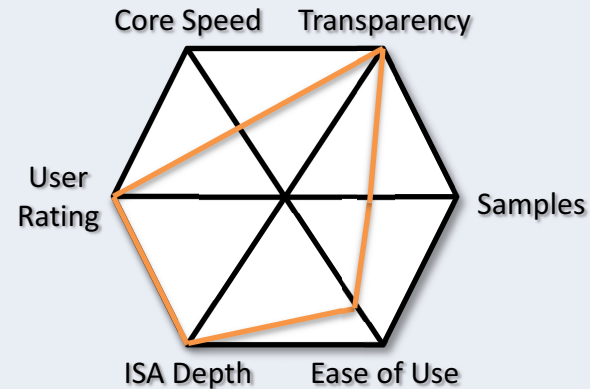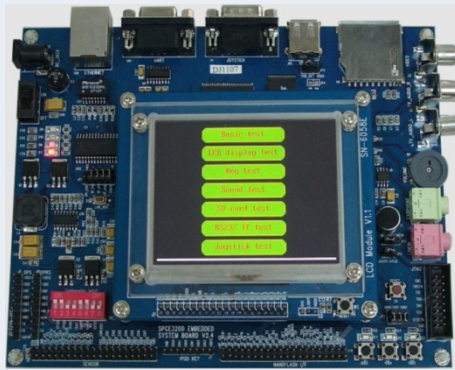
Processor	Sunplus S⁺core
Memory	128Mb SDRAM, 64Mb NOR Flash, and 128Mb NAND Flash
Interface	SPI, SIO, I^2S, I^2C, UART, USB, Ethernet, and GPRS
Peripherals	Joystick, Touch Panel, 3 Buttons, and 3 LEDs
Multimedia	TV Out, 3.5" TFT LCD, CMOS Camera, and Audio CODEC
Other Interface	SD Card Slot, SJTAG, and GPS

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Learning Indices of ANDES ADP-XC5FF676
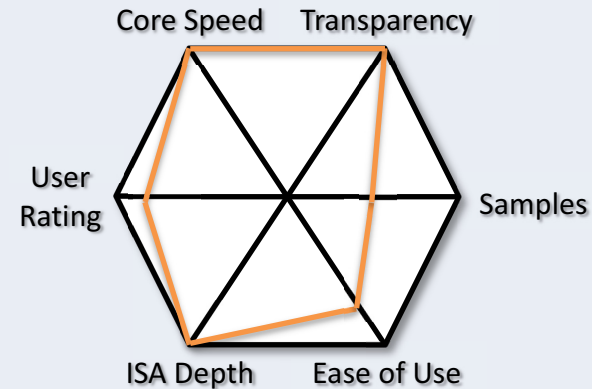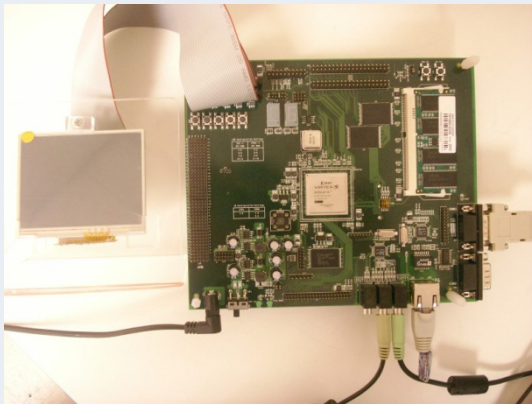
ANDES ADP-XC5FF676
Processor — AndesCore N1213S (Softcore on Xilinx XC5VLX110)
Memory — 256MB SODIMM SDRAM and 32MB NOR Flash
Interface — I^2C, 2 UARTs, and Ethernet
Peripherals — Touch Panel, 5 Buttons, and 2 LEDs
Multimedia — 3.5" TFT LCD and AC97 Compliant CODEC
Other Interface — SD Card Slot, JTAG, AHB, X-Bus, and MII

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Learning Indices of ITRI PAC Duo

ITRI PAC Duo
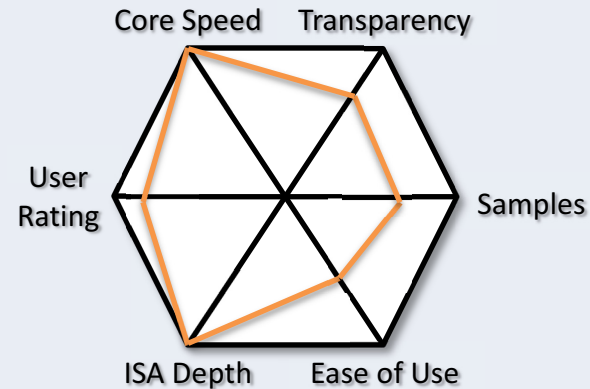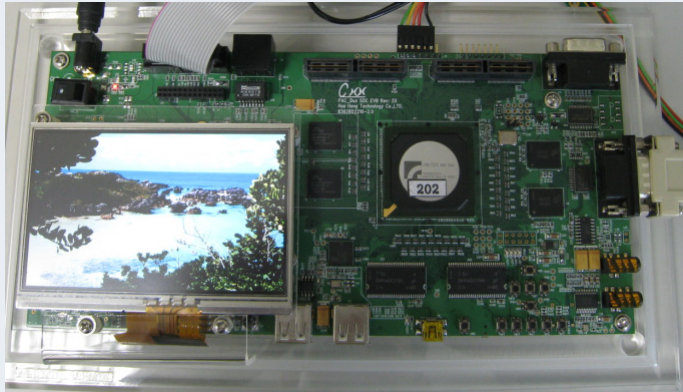
Processor	ARM926EJ-S + PACDSP V3X
Memory	128Mb SDRAM, 128Kb SRAM and 128Mb NOR Flash
Interface	IrDA, SIO, I^2S, I^2C, UART, USB, and Ethernet
Peripherals	Touch Panel, Buttons, and LEDs
Multimedia	4.3" TFT LCD and AC97 Compliant CODEC
Other Interface	SD Card Slot and AHB

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DISCUSSION AND CONCLUSION

Discussion

- ## A Guide for Hardware Selection

  – The Universal Study Platform provides a clearer way for hardware selection.

- ## Students' Experience

  – The learning level that we suggested can correspond to students' requirements.

  – The platforms are suitable for the students to learn embedded software design.

Conclusion

- ## An Experience of Promoting ESW Education in Taiwan
  - An universal study platform that shares resources for ESW education was established by CIC.
  - The platform integrates software resources of many hardware kits and suggests a learning level for each hardware kit.
  - Example: Three domestic hardware kits are introduced in the project.

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Conclusion

- An Experience of Promoting ESW Education in Taiwan

  – From the experience of students and teachers, the domestic hardware kits are suitable for ESW education.

  – Other hardware kits can also be used in the proposed platform. A student can select the most suitable hardware kit using the information of learning level / indices.

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