Beijing University of Technology

IA based Embedded System Curriculum

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IA based Embedded Curriculum Summary

Course Name: Embedded System architecture

Course Type: both PPT & Hands-on

Target Student/Semester: Junior in Computer Science and Technology

Student Number (per year): 30~50

Course Duration: 32 Hours

Prerequisite Courses: Computer interface technology, Operating system, C Language
IA based Embedded Curriculum Characteristic

The Curriculum require to understand the architecture of CISC（Atom） and RISC（ARM） microprocessors applied in the embedded field. Familiar with the embedded OS’s basic principles and concepts. Customize the Windows Embedded OS, design the driver components based on the hardware platform and the application needs, then write the applications.
1. Teaching methods

Courses based on the engineering design, involving the use of development environment and tools, If we use the teaching methods of the past: First teach in the classroom, and then experiments in the laboratory, Not only make students feel boring and difficult to master, but also to spend time to review before the experiment. Therefore, We learned from the Teaching philosophy of “Learning by doing” first proposed by the U.S. Carnegie. Mellon University. This philosophy is to strengthen the comprehensive practical ability of engineering students and engineering literacy.
2. Evaluation methods

Experiment and curriculum design

curriculum design: Provide a number of subjects (annually update), given scores according to the degree of difficulty of the subjects, students choose the subjects to accomplish according to their ability.
3. Experimental environment
4. Teaching Achievements

2010, the courses of Embedded system architecture selected for the Ministry of Education - Intel excellent course construction projects.

Website: http://atom.bjut.edu.cn

2005, the courses of Embedded System selected for the Ministry of Education - Microsoft excellent course construction projects

Website: http://windowseembedded.bjut.edu.cn
5. **Cooperation with the high-tech enterprises**

Cooperation with the high-tech enterprises, Continuously update course content, introduce students the latest technology in the industry

*Intel: Embedded microprocessor*

*Microsoft: Windows Embedded*

*Altera: FPGA/SOPC*

*Atmel: AVR Microcontroller*
2004, Established the “Beijing University of Technology and Intel Corporation Joint Embedded System Laboratory”. Intel donated 15 sets of embedded experiment platform to the school based on XScale. And organized the training of the Intel embedded system teaching.
2009, Established the “Intel-Beijing University of Technology Joint Lab of Embedded Technology”, Intel donated 17 sets of experiment platform to the school based on the Atom microprocessor.
July 2011, we hosted the Intel Embedded System Curriculum Training-cum-Senior Seminar of the backbone of the Young College Teachers
6. **Students’ embedded technology contest**

For part of the practical ability of the students, organize them to participate in the embedded systems competition at home and abroad, and achieved excellent results.

Stimulate students' interest in learning by competition. The competition and training base was established for embedded systems technology in 2006.
Intel Cup Undergraduate Electronic Design Contest — Embedded System Design Invitational Contest

Smart CBS

Sampling
Sampling and analyzing pulse statistics from radial artery through sensors

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diastolic Pressure</td>
<td>70 mm Hg</td>
</tr>
<tr>
<td>Systolic Pressure</td>
<td>115 mm Hg</td>
</tr>
<tr>
<td>Differential Pressure</td>
<td>40.00 mm Hg</td>
</tr>
<tr>
<td>Mean Arterial Pressure</td>
<td>88.87 mm Hg</td>
</tr>
<tr>
<td>Cardiac Output</td>
<td>3.18 L/min</td>
</tr>
<tr>
<td>Stroke Index</td>
<td>32.94 mm Hg/min</td>
</tr>
<tr>
<td>Total Peripheral Resistance</td>
<td>1.59 KU</td>
</tr>
<tr>
<td>Stroke Volume</td>
<td>54.54 ml/beat</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>70.15 beats/min</td>
</tr>
<tr>
<td>Body Surface Area</td>
<td>1.03 ft²</td>
</tr>
<tr>
<td>Cardiac Index</td>
<td>2.31 L/m²/beat</td>
</tr>
<tr>
<td>Artery Compliance</td>
<td>1.21 m²/min/beat</td>
</tr>
</tbody>
</table>

User ID: 1  Height: 175 cm  Weight: 60 kg

Embedded Fitness System with Human-body Induction
Windows Embedded Student Challenge

Sports Personal Assistant
2005, won the prize of HONORABLE MENTION TEAM AWARD held by IEEE at the sixth Computer Society International Design (CSIDC). This is China's first entry into the highest level of competition of the international computer industry (TOPTEN).
IA based Embedded Curriculum Key Points

1. Familiar with the structure of Atom experimental platform
2. Master the building environment of Windows Embedded Standard operating
3. Understand the customization process of Windows Embedded Standard operating system
4. Master the use of development tools of WES2009
5. Master the extraction method of hardware information
6. Master the import method of WES2009’s component database
7. Master the customization method of WES2009’s image
8. Master the method of making various boot disk
9. Master the structure of the driver and the component’s design method
IA based Embedded Curriculum Difficult Points

1. Setting up the development environment
2. making a variety of media-based boot disk
3. Designing the driver components
IA based Embedded Curriculum Experience Sharing

Lab1: Customization Of Windows Embedded Standard Operating System
Lab2: Design the TSC Driver Component
IA based Embedded Curriculum Hands-on Practice Case Sharing (1)

Case Name: Customization Of Windows Embedded Standard Operating System

Case Attribution: basic of the WES2009 experiment

Case Objective:

• Familiar with the structure of Atom experimental platform
• Master the building environment of Windows Embedded Standard operating
• Understand the customization process of Windows Embedded Standard operating system
• Master the use of development tools of WES2009
• Master the extraction method of hardware information
• Master the import method of WES2009’s component database
• Master the customization method of WES2009’s image
• Master the method of making various boot disk
1. **Extract the target device hardware information**

- **Install Windows XP on the target device**
- **Run TAP under C:\Program Files\Windows Embedded\utilities, at this point outputting the file device.pmq**
- **You can also specify the output file path and name, TAP /O [path\file name], as shown below**
At this point, in the current folder it will output a file for: Z510.pmq, which is the hardware information file of target device.
2. Make components in the Component Designer

- Start Microsoft Component Design
- Followed by clicking File → Import, open the appropriate .pmq file
• **Start to import**
<table>
<thead>
<tr>
<th>Name</th>
<th>Component or Group</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACPI Lid</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>ACPI Multiprocessor PC</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>ACPI Power Button</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Audio Codecs</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>CD-ROM Drive</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Communications Port</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Direct Parallel</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Disk drive</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Full screen video driver for console</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>HID Keyboard Device</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>HID-compliant consumer control device</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>HID-compliant mouse</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>High precision event timer</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel Processor</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel(r) 82802 Firmware Hub Device</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel(R) SCH Family PCI Express Root Port 1 - 8110</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel(R) SCH Family PCI Express Root Port 3 - 8112</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel(R) SCH Family USB Universal Host Controller - 8114</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel(R) SCH Family USB Universal Host Controller - 8115</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel(R) SCH Family USB Universal Host Controller - 8116</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel(R) SCH Family USB2 Enhanced Host Controller - 8117</td>
<td>Component</td>
<td>At least one</td>
</tr>
<tr>
<td>Intel(R) SCH LPC Interface Controller - 8119</td>
<td>Component</td>
<td>At least one</td>
</tr>
</tbody>
</table>
• **Save:** Followed by clicking File → Save, type the file name after choosing the path, save as SLD file
3. **Import the component into the component database**
   - Start Component Database Manager (you must close the Component Designer before), click Import
• Select the SLD file to import, click Import
• Close the component database manager when the import is successful
• If you want to view, you can click the Component tab before close, and then view in the Component window.
4. **Customize WES OS image**

- **Start Target Designer**

- **Create a new configuration file**

![Target Designer](image)

![New Configuration](image)
• **Target device settings**

![Z510 Settings and Components](image)

![Windows Embedded Standard (x86) Run-time Image Licensing](image)

![Target Device Settings](image)

- **Boot drive (more info)**: C:
- **Windows folder (more info)**: C:\WINDOWS
- **Program Files folder (more info)**: C:\Program Files
- **Documents and Settings folder (more info)**: C:\Documents and Settings
- **Boot ARC path (more info)**: multi(0)disk(0)rdisk(0)partition(1)
- **Boot partition size (MB) (more info)**: 1024
- **Partition cluster size (bytes) (more info)**: 4096
• **Add macro components**
- Dependencies checking

Followed by clicking Configuration → Check Dependencies, or clicking F5, or clicking the shortcut button.
There are five errors in examination results, after handling errors, check the dependencies again until the error-free.
• **Generate OS image**

*Followed by clicking Configuration → Build Target Image..., or clicking F7 , or clicking the shortcut button*
After setting, click “Build”. After generating error-free, click “Close”
5. **Deploy OS Image**

① **Make Hard disk to boot**

- **Make the hard disk into DOS boot disk**
- **Copy BOOTPREP.EXE under the C:\ Program Files\ Windows Embedded\ utilities directory to boot disk**
- **Run BOOTPREP.EXE under DOS, make boot into NTLDR**
② Make U disk to boot

- Enter the DOS command line

Run **UFDPREP <the letter of target U disk>** under the directory of **C:\Program Files\Windows Embedded\utilities**
• Select “Y” if it needs to be formatted
UFD command

C:\WINDOWS\system32\cmd.exe

C:\Documents and Settings\Han Degiang>Cd\Program Files\Windows Embedded\utilities

C:\Program Files\Windows Embedded\utilities>ufdprep /?
Microsoft (R) UFD Preparation Tool for Windows Embedded
Copyright (C) Microsoft Corporation 2006. All rights reserved.

Usage:

/y      Suppress confirmation prompt
/verify Check to see if the media is formatted properly, no changes made
/size   Display the size of the drive in MB
/size=n Create a partition of size n in MB
/ntfs   Format the partition using the NTFS file system
<letter>: Specify the media’s drive letter with no ‘\’

Examples:

ufdprep /y x:
ufdprep /verify g:
ufdprep /size=100 /ntfs

C:\Program Files\Windows Embedded\utilities>
③ Copy the “Image” to the boot disk

• Copy all of the files and folders in the directory, “X:\Windows Embedded Images” to the boot disk
④ First Boot Agent (FBA)
⑤ Result
IA based Embedded Curriculum Hands-on Practice Case Sharing (2)

Case Name: Design the TSC Driver Component

Case Attribution: Difficulty and focus point of the WES2009 experiment

Case Objective:
- Master the structure of the driver
- Master the design method of the driver component
- Master the debug method of the driver component
The driver component is provided by the Installation file (setup.exe), while the executable file can not directly be used for the development of the driver module, it must backup the driver module of the target machine by using the intelligence driver backup program, such as “DriverMax” or “Windows”.

![DriverMax - Version 5.5]

If you are planning a Windows reinstallation you can export all drivers to a folder or a compressed file. After reinstalling Windows you will have everything in one place!
• *Start the component designer, click the “File -> Import”*
 INF Processing Options

File name: D:\WES Driver\Z510 Drivers\Touchkit Driver\Touchkit.inf

Parsing Options:
- [ ] Automatic
- [ ] Custom

Section Name | Type
--- | ---

Import File

Platform: Windows Embedded Standard (x86)

File: D:\WES Driver\Z510 Drivers\Touchkit Driver\Touchkit.inf

Log file: 

Status: Click start to import file.

Ready to start import session...

Start | Close | Help
Import File

Platform: Windows Embedded Standard (x86)
File: D:\WES Driver\Z510 Drivers\Touchkit Driver\Touchkit.inf
Log file: 
Status: Completed processing file

Completed processing file [Import succeeded]

File: "D:\WES Driver\Z510 Drivers\Touchkit Driver\msmouse.inf" included INFs.
Import File

Platform: Windows Embedded Standard (x86)

File: D:\WES Driver\Z510 Drivers\Touchkit Driver\Touchkit.inf

Log file: 

Status: Completed processing file [Import succeeded]

D:\WES Driver\Z510 Drivers\Touchkit Driver\Touchkit.inf: [xtouch_AddR]
D:\WES Driver\Z510 Drivers\Touchkit Driver\Touchkit.inf: [DLLCopyFile]
D:\WES Driver\Z510 Drivers\Touchkit Driver\Touchkit.inf: [usb_AddRea]

Completed processing file [Import succeeded] : D:\WES Driver\Z510

Import session completed successfully
When saved, import to component database

<table>
<thead>
<tr>
<th>Component Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: USB Touchscreen Controller</td>
</tr>
<tr>
<td>Version: 5.0.1.5310</td>
</tr>
<tr>
<td>Owners: Han Deqiang</td>
</tr>
<tr>
<td>Vendor: BJUT</td>
</tr>
<tr>
<td>Date created: 2010-4-1 0:55:37</td>
</tr>
<tr>
<td>Date revised: 2010-4-1 1:02:09</td>
</tr>
<tr>
<td>Description: USB Touchscreen Controller (Professional)</td>
</tr>
</tbody>
</table>

| Platform: Windows Embedded Standard [x64] |
| Repository: USB Touchscreen Controller Files |
| Prototype: Device: Mouse |
| Component help: |
| HTML title: |
| Component DHTML: |
| Component script: |
| Visibility: 1000 |

- Macro component
- Component instances are editable
- Enable multiple instances
- Opaque
IA based Embedded Curriculum Resource

Website: [http://atom.bjut.edu.cn](http://atom.bjut.edu.cn)
Innovation: Hardware Comprehensive Experiment System

Base on FPGA Microcomputer interface
Embedded System

- LCD
- Atom Microprocessor
- FPGA
- Keyboard Switch
- LED
- 7 Seg. LED Display
- LED Array Display
- ADC/DAC
- PCI/PCIE
Thank You!