ĐẠI HỌC QUỐC GIA TP.HỒ CHÍ MINH
TRƯỜNG ĐẠI HỌC BÁCH KHOA
KHOA ĐIỆN-ĐIỆN TỬ
BỘ MÔN KỸ THUẬT ĐIỆN TỬ

Master Course

Advanced Embedded System Design

Chapter 0: Course Introduction

Course Information

- Instructor
  - Truong Quang Vinh, Ph.D.
  - Department of Electronics
    http://www.dee.hcmut.edu.vn/vn/bomon/bmdientu
  - Email: tqvinh@hcmut.edu.vn
  - Homepage: http://www4.hcmut.edu.vn/~tqvinh
  - Office: 116B1, IC Design Lab, Monday 9-11am
- Related undergraduate courses:
  - Micro-processor (Vi xử lý)
  - Embedded system design (Thiết kế hệ thống nhúng)
  - Embedded programming (Lập trình nhúng)

Textbooks

[1] Frank Vahid and Tony Givargis , **Embedded System Design: A Unified Hardware/Software Approach,** John Wiley & Sons, Inc. 2002

[2] Joseph Yiu, **"The Definitive Guide to the ARM Cortex-M3"**, Elsevier Newnes, 2007

[3] Jonathan W Valvano, **Embedded Systems: Introduction to Arm® Cortex(TM)-M Microcontrollers** (Volume 1), 2012

[4] Jonathan W Valvano, **Embedded Systems: Real-Time Interfacing to Arm® Cortex™-M Microcontroller**, 2012

Course Description

- This course provides students with advanced knowledge of embedded system design process.
- Students will have ability to
  - **design** hardware part of an embedded system using ARM microcontroller with peripherals including GPIO, ADC, UART, SPI, USB, and Ethernet.
  - **program** software part of an embedded system with and without operating system using C programming language.
  - **develop** an embedded system project using Proteus, IAR, and KeilC development tools.

Syllabus

Week	Content	Note
1	**Chapter 0: Course introduction** 0.1. Course information 0.2. Syllabus and schedule 0.3. Course preparation Require students to prepare textbooks, tools, and course materials	Students select class project's topics
2	**Chapter 1: Embedded System Design Process** 1.1. Embedded system features and issues 1.2. Embedded system design process 1.3. Embedded system analysis Require self-studying for 3 hours	Quiz
3,4	**Chapter 2: Microcontroller Series** 2.1. ARM Cortex-M3 2.2. ARM Cortex-M4 Require self-studying for 6 hours	Assignment 1

Syllabus

5,6	**Chapter 3: C Programming for Embedded Systems** 3.1. C Program Basics 3.2. ARM Cortex-M C Compiler 3.3. ARM software library 3.4. FreeRTOS Require self-studying for 6 hours	Assignment 2
7	**Chapter 4: Development tools** 4.1. Advanced simulation with Proteus 4.2. Programming tools: IAR and Keil Require self-studying for 3 hours	Assignment 3
8,9	**Chapter 5: Using Peripherals and Interrupts** 5.1. Parallel IO ports 5.2. Timers 5.3. Interrupts 5.4. Analog IO 5.5 Serial communication Require self-studying for 6 hours	Assignment 4

Syllabus

10	**Chapter 6: Designing an embedded system project** 6.1. Project description 6.2. Hardware design 6.3. Software design 6.4. Design simulation 6.5. Design verification Require self-studying for 3 hours	
11-15	**Experiment** 1. ARM Cortex M3 with Stellaris LM3S9B96 kit 2. ARM Cortex M4 with Stellaris EK-LM4F120XL kit Require self-studying for 10 hours	Students do experiments at lab
16-19	**Class project** Each group of students do class project at lab	Students do class projects
20	**Present class project** Each group of students presents and reports the class project	Students report class projects

Grading

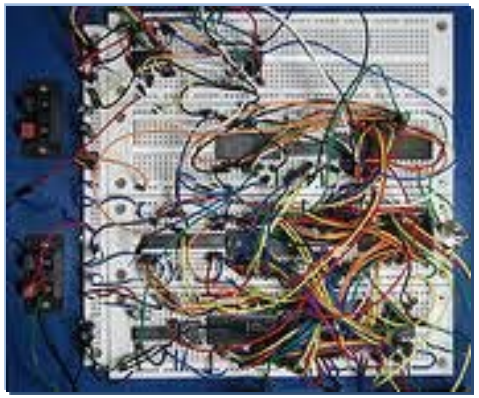
- Midterm exam: 20%
- Final exam: 50%
- Lab: 10%
- Project: 20%
  - 2-3 students for one group
  - Select project's topic at **week 3**
  - Submit project at **week 16**

Course Preparation

- Textbooks:
  - download 3 required textbooks
- Software tools:
  - IAR
  - KeilC
- Programming knowledge:
  - C/C++ programming

Project's requirements

- Report in MS Word (follow embedded system design process)
- Simulate the design
- Make prototype by bread board or PCB board.
- Present the design in class



Development Boards

FriendlyARM Mini2440 Board

ARM9 board, 400 MHz, 64MB RAM, 256MB Nand, 3.5" Touch screen LCD

Giá : 2,399,000 VND / Cái

LM4F120 LaunchPad Evaluation

Stellaris® LM4F120 LaunchPad Evaluation

Giá : 550,000 VND / Cái

BeagleBoard-xM

ARM Cortex -A8 MHz Board, 512MB RAM, 1 GHz CPU, BeagleBoard

Giá : 4,299,000 VND / Cái

STM32F4-Discovery Cortex-M4 Kit

STM32F4 DISCOVERY (ARM Cortex M4 + DSP Core)

Giá : 449,000 VND / Cái

STM32F3 Discovery

KIT EVAL DISCOVERY STM32F3

Giá : 460,000 VND / Cái

STM32F4Discovery EXTBOARD

STM32F4 mother board, RS232 , LCD touch, CAN, Network

Giá : 1,199,000 VND / Cái

Arduino Due R3

SAM3X8E ARM Cortex-M3 CPU, 84Mhz, 96 KBytes SRAM

Giá : 899,000 VND / Cái

Raspberry Pi Model B

(Made in UK) BCM2835 700MHz ARM1176JZFS processor with FPU and Videocore 4 GPU

Giá : 1,235,000 VND / Cái

Note: Friendly ARM, LM4F120 LaunchPad, BeagleBoard-xM are **available** at the Lab 116B1

Recommended class project topics

Using **STM32F3-Discovery Kit / STM32F4-Discovery Kit/ LM4F120 LaunchPad**

1. Hand motion detection
2. Remote Control through Ethernet
3. Temperature & humidity measurement
4. Solar control system
5. Motor control system

Using **Friendly ARM kit / Beagle Board / Raspberry Pi**

1. Image capturing system
2. Data acquisition system
3. Object detection & recognition
4. Remote Control through Ethernet
5. MP3 system

Simple project's Topics

1. 20-Chasing LEDs (at least 10 modes)
2. LED Message Board (8x32)
3. 3D-LED cube (3x3x3)
4. LED fan display
5. Two-LED Dice
6. Two-digit 7-Segment LED counter up/down
7. Digital clock with LCD display
8. Voltmeter with LCD display
9. Calculator with keypad and LCD
10. Serial communication-based calculator
11. Step motor controller
12. DC motor controller using PWM
13. I2C data communication
14. Battery charger (1A)
15. Temperature controller
16. Alarm controller using IR LED
17. Automatic light controller
18. Simple music keyboard
19. Digital door lock
20. SD card project

Course Overview

1. What is an embedded system?
2. What are differences between embedded system and general computer system?
3. What are applications for embedded systems?
4. What is the most important part in an embedded system?
5. Which kind of embedded system development boards have you practiced on?
6. Which kind of micro-processors do you have experience on?