Embedded Operating Systems

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An Real-Time OS: µC/OS-II Quick Overview

Introduction of µC/OS-II (1/2)

- The name is from micro-controller operating system, version 2
- µC/OS-II is certified in an avionics product by FAA in July 2000 and is also used in the Mars Curiosity Rover
- It is a very small real-time kernel
  - Memory footprint is about 20KB for a fully functional kernel
  - Source code is about 5,500 lines, mostly in ANSI C
  - It's source is open but not free for commercial usages
- Preemptible priority-driven real-time scheduling
  - 64 priority levels (max 64 tasks)
  - 8 reserved for µC/OS-II
  - Each task is an infinite loop

Introduction of µC/OS-II (2/2)

- Deterministic execution times for most µC/OS-II functions and services
- Nested interrupts could go up to 256 levels
- Supports of various 8-bit to 64-bit platforms: x86, ARM, MIPS, 8051, etc.
- Easy for development: Borland C++ compiler and DOS (optional)
- However, uC/OS-II still lacks of the following features:
  - Resource synchronization protocol
  - Soft-real-time support

The µC/OS-II File Structure

Application Code (Your Code!)

Processor Independent Implementations

- Scheduling policy
- Event flags
- Semaphores
- Mailboxes
- Event queues
- Task management
- Time management
- Memory management

Application Specific Configurations

- OS_CFG.H
- Max # of tasks
- Max Queue length
- …

uC/OS-II Port for Processor Specific Codes

Software

Hardware

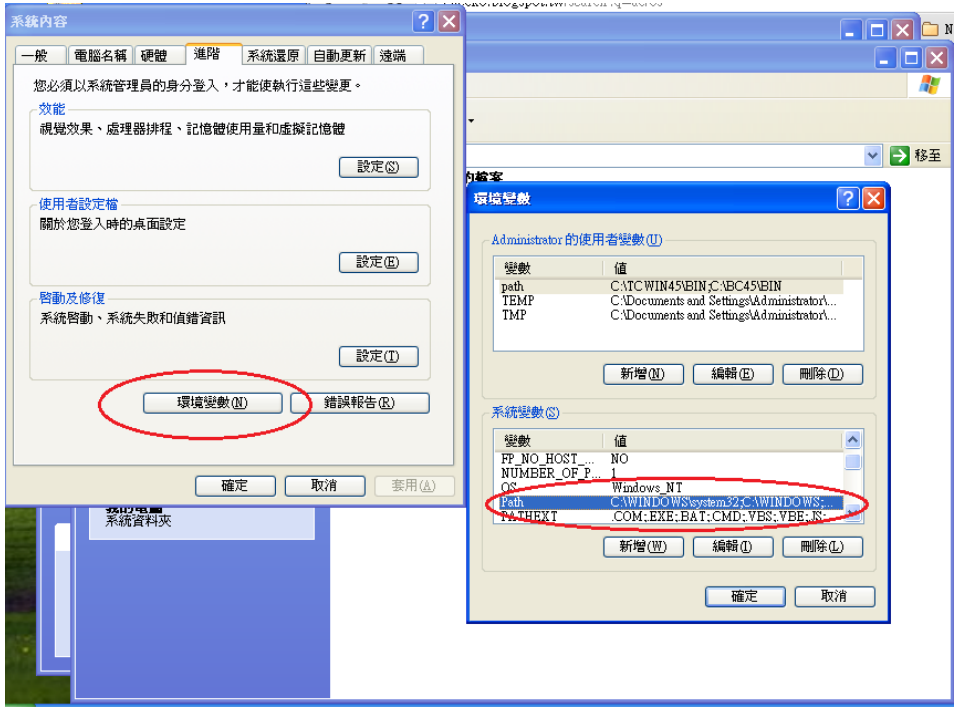
CPU | Timer

Requirements of µC/OS-II Emulator

- Operating System
  - Windows XP 32bits
  - Use virtual machine to install the OS
  - Install “Guest Additions” for Virtualbox
- Tools
  - Borland C++ compiler (V4.5)
    - BC45 is the compiler
  - Turbo Assembler
    - The assembler is in tasm
  - The source code and the emulation environment of µC/OS-II
    - SOFTWARE is the package
- Full Package
  - Download it from the course website with password: csie2018

Borland C++ Compiler

- Download Borland C++ and install it on your windows XP environment
  - Double click the "INSTALL.EXE"
- Add ";C:\BC45\BIN" to your system Path



Turbo Assembler

- Download Turbo assembler and unzip the file
- Copy "\tasm\BIN\TASM.EXE" to your "C:\BC45\BIN"
  - Include the missing assembler which is going to be used during we compile the source code of μC/OS-II

Compile µC/OS-II Example Code

- Download the source code and emulator µC/OS-II
  - It is recommended to put the source code package "SOFTWARE" directly in C:\
- Test the first example
  - Execute C:\SOFTWARE\uCOS-II\EX1_x86L\BC45\TEST\TEST.EXE
  - Press ECS to leave
- Rename or remove the executable file
  - Rename TEST.EXE
- Compile the µC/OS-II and the source code of the first example
  - Run C:\SOFTWARE\uCOS-II\EX1_x86L\BC45\TEST\MAKETEST.BAT
  - A new "TEST.EXE" will be created if we compile it successfully

Common Mistakes

- Did you directly put the package “SOFTWARE” in C:\ ?
- Have you copied the correct file “TASM.EXE” to your “C:\BC45\BIN” directory?
- Did you set the Path correctly?
  - See the picture in Page 7
  - There is no space

Extra Exercise

- Read the e-book of μC/OS-II
  - Try to read and understand the first 3 chapters
- Read the source code to understand the application
  - The application source code is in C:\SOFTWARE\uCOS-II\EX2_x86L\BC45\SOURCE and C:\SOFTWARE\uCOS-II\EX3_x86L\BC45\SOURCE and C:\SOFTWARE\uCOS-II\EX4_x86L\BC45\SOURCE
- Browse the source code of μC/OS-II
  - The source code of μC/OS-II is in C:\SOFTWARE\uCOS-II\SOURCE
- The grading baseline is 80

Report

- Each student should write a report
- Only two A4 pages
- Use 12 pt font
- Deadline is 23:59 2019/10/28
  - Please keep the sent log
- File name: EOS-Homework-StudentID
- File type: PDF or Word
- Send it to TA's email: chewei@mail.cgu.edu.tw
- Email title: EOS Homework StudentID