OUTLINE

- Introduction to Embedded Systems and PIC
- Introduction to Hardware and Software Tools
- Information about HWs and Term Project
“The World Runs on Embedded Software”
Some Statistics

Over 8 billion embedded microprocessors are produced each year (May 2006). The number is expected to increase dramatically in the next decade.

This is more than %90 of world processor market.
Microcontroller vs Microprocessor

Microcontroller:
• Very little external support hardware.
• Most RAM, ROM and peripherals on chip.
• “Computer on a chip”, or “System on chip” (SOC)

Microprocessor:
• Requires ‘external’ support hardware
• E.g., External RAM, ROM, Peripherals.
There are lots of microcontroller manufacturers

- Microchip
- ARMEL
- Texas Instruments
- Intel
- Motorola
- Philips
- Dallas Semiconductor
- Xilinx
- Infineon Technologies
- ST
- Zilog
- Holtek
We will use

PIC (Peripheral Interface Controller)
PICs use the Harvard Architecture

- Used mostly in RISC (Reduced Instruction Set Computer) CPUs
- Separate program bus and data bus: can be different widths!
- For example, PICs use:
  - Data memory (RAM): a small number of 8bit or 16bit registers
  - Program memory (ROM): 12bit, 14bit, 16bit or 24bit wide (in EPROM, FLASH, or ROM)
The PIC Microcontrollers (MCU) & dsPIC Digital Signal Controllers (DSC) Families
We will use PIC16F877 and PIC18F4520
PIC16F877

- 14bit core - 35 instructions
- 200ns instruction time (Tclk = 20MHz)
- 8,092 14bit FLASH program memory
- 368 8bit data memory or registers ("File registers")
- 256 8bit EEPROM (nonvolatile) data registers
- 8 level hardware stack
- Interrupt capability (up to 14 sources)
- 33 pin I/O (for 40 pin package)
- 3 Timer/Counter modules
  - Timer0: 8-bit
  - Timer1: 16-bit
  - Timer2: 8-bit
PIC16F877

- Two Capture, Compare, PWM modules
  - Capture: 16-bit
  - Compare: 16-bit
  - PWM: max. resolution is 10-bit
- 10-bit 8 channel Analog-to-Digital Converter
- Synchronous Serial Port (SSP) with SPI and I2C
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) 8-bit
Hardware Tool: PIC DEMO BOARD

Features:
• 18, 28 and 40-pin MCU support
• Parallel port programmer
• RS232 Serial interface
• USB interface with 28-pin MCU
• 4x4 Keypad
• 7-Segment displays
• Led display
• 16x4 LCD
• Infrared transmitter/receiver
• I2C Serial EEPROM
• Speaker
• Potentiometer for ADC
Software Tools

For PIC16F877:
- MPLAB IDE with PIC Assembler
- SDCC - Small Device C Compiler open source development tool (from command line)

For PIC18F4520:
- We will use FreeRTOS open source development tool.
  - MPLAB IDE with MPLAB C18 Compiler (Student edition)

WinPic800
- To program the PIC on the development board
Resources

- Datasheet(s) ***MUST IMPORTANT!!!***
- Alper & Fatih
- Internet
  - Course’s web site
    http://www.ceng.metu.edu.tr/courses/ceng336/
  - Vendor’s web site
    - www.microchip.com,
      http://forum.microchip.com
  - Your friends (not recommended 😞)
HWs and Term Project

• 4 HWs (PIC16F877) + 1 Term Project (PIC18F4520)
• 1st HW → Coding in PIC assembler language
  • Individual
  • No demonstration
• 2nd, 3rd and 4th → Implementation on PIC Demo Board
  • Group work (3 Students) but individual grading.
  • You will make demonstration.
  • 2nd HW in PIC assembler language
  • 3rd and 4th is SDCC (Small Device C Compiler)
• 1 Term Project
  • FreeRTOS to be used
HWs and Term Project

- Grading

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- Cheating Policy
  Any student involved in cheating will be remained pointless from all HWs and Term Project.