COURSE DETAILS

Instruments
General Instrumentation Logic Labs

Why MSP430?	Day-1

This presentation describes the use of MSP430 microcontroller family in the fields of wireless sensor network, advanced instrumentation, and automotive electronics. This family was chosen due to its characteristics, capabilities, low-cost, easy to use development tools, and the large variety of devices and peripherals available within the MSP430 family. Applications developed by the Microprocessors Working Group at Gill Instruments Bangalore will be discussed. These applications include real time protocols, implementations in sensors, devices for patient monitoring, and the development of a MSP430 advanced learning kit with extended capabilities like USB, wireless, and Ethernet communications.

Outline

- Why MSP430?
- Choosing hardware
- Introduction to MSP430
- Design and Development tools

Getting Started with the MSP430	Day-1

New to the MSP430 or looking for a refresher? This presentation is the place to start. Learn the basics of the instruction set, addressing modes, unified memory model, and development tools. Exercise your new knowledge with the "starting from a blank screen" lab, where you will enter the few lines of code required to flash LEDs on a demonstration board.

Outline

- What is the MSP430?
- MSP430 architecture
- MSP430 CPU, instruction set, and addressing modes
- MSP430 I/O

Introduction to Ultra-Low-Power with the MSP430	Day-1

Pick up where "Getting Started with the MSP430" left off and learn about the ultra-low-power (ULP) architectureand techniques of the MSP430. Starting with an interrupt-driven-architecture concept this class walks you through interrupt handling and low power modes on the MSP430. Next dive into the heart of ULP – the MSP430 clock system and learn how to leverage it to the fullest extent for the lowest power consumption possible. Finally experience the MSP430 low power mode by programming a demonstration board for ultra-low-power modes.

Outline

- ULP defined
    - Stand-by
    - Wake-up
- Exploiting Low-Power Modes
    - Low-Power Modes
    - Clocking options
    - Entering and exiting modes
- Interrupts
- MSP430 clock system
- Overview of the Comparator A peripheral

Tips and Tricks with Timer A	Day-2

Explore Timer A, one of the MSP430's most widely used and versatile peripherals. Use this module in ways you may have never previously considered. See how the synchronized capture feature can be used to implement a Tone decoder with very little CPU overhead. Extend the 16-bit range with software to precisely capture and generate longer time intervals with high precision. Generate three independent PWM signals, learn about the timer's trigger capabilities for controlling sample and hold, and see how easily Manchester coding/decoding can be achieved. Leave with the techniques to maximize utilization of Timer A.

Outline

- Overview of TimerA
- Timer block functionality
    - Interrupt handling
    - Extending the 16-bit range
    - Compare and capture modes
- Generating PWM signals
    - Multiple output duty cycles from same timer
    - Adjusting the duty cycle
    - Mixing PWM with other modes
- Low-overhead UART implementation
    - Signal and timing considerations
    - TimerA synchronized latch feature
- Lab: Extended range and using efficient interrupt handling

Enabling A/D Conversion DAC Interface	Day-2

Expand your knowledge of the newly enhanced ADC12 peripheral. Witness the new features of the module including an input multiplexer for up to 8 channels and the ability for sample-and-hold. You will also learn numerous applications using ADC12 including speech storage and generation. Operate ADC12 and store data while CPU is asleep using DMA. Real-world examples and demonstrations, including a smoke detector application, will be shown.

Outline

- Discussion of the new Applications
- Utility metering
- Portable instrumentation
- Intelligent sensors
- Using the DAC to generate square wave, Ramp, Triangular, and sine wave.
- Temperature sensor and reference.

Real world implementation: Temperature monitor / Smoke detector application

Exploiting MSP430 Flash and LCD	Day-2

MSP430 is endowed with very high quality, byte writable, small sector flash. The unique capabilities of the MSP430 Flash Memory provides the ability for many new applications in smart instrumentation, security, and automotive. Working on a user interface? Discover how the LCD can simplify your Monitor and control applications without the need for external components. Gain knowledge while configuring and using the LCD module in hands-on labs.

Outline

- LCD Module
    - Introduction to LCD 16x2
    - Writing to LCD in command and Data mode
    - Configuring and using the LCD module
    - Biasing options
    - Timing

New High-Performance, Dual Communication Module – USART	Day-3

Experience the added performance and flexibility present in the MSP430's newest communication module, USART. The USART features a wide range of communication options for higher-end systems including SPI, I2C, UART/USCI, LIN, and IrDA. Also included is a dual simultaneous communication channel option. See how the USART/USCI module expands communication capabilities and learn which communication bus is best suited to your application. Learn how to save power by using DMA together with USART.

Outline

- Introduction to USART/USCI
  - Feature overview
  - UART/USCI communication modes
  - Device Selection
- SPI
  - Modes of communication
  - Data and clocking options
- I2C
  - Hardware features
  - Interrupts and software flow
- RS-232/RS-485
  - Master/slave bus configuration
  - Host interface
  - Addressing and error handling

MSP430 FIR digital Filter	Day-3

When higher order filters are combined with faster sampling rates, the demand on the processor becomes very high. This limits typical MCU's to handle a real-time FIR filter algorithm only at low sample rates and with a reduced number of filter taps.

The MSP430F1611 with its rich peripheral set handles the FIR filter algorithm in a different manner compared to conventional MCUs. This device has a three channel DMA peripheral that handles the required data, coefficient, and result movement between the memory and the MAC, dramatically improving the computation efficiency of the real-time FIR filter algorithm running on-chip. This allows the same filter program to be used for any type of FIR filter implementation such as high-pass, low-pass, band-pass, and band-reject filters. The integrated digital-to-analog converter, DAC12, can be used for converting the filter output back into the analog domain if required.

Outline

- Introduction to 3 channel DMA , MAC, and 2 channel DAC
- Self-Test of DMA and DAC
- FIR Filter Software Algorithm
- Calculating the FIR Filter Coefficients
- DMA-MACS-Memory Combination

Real world implementation: High-pass, low-pass, band-pass, and band-reject filters.