PANYA TECHNOLOGIES

Technology to Live…

#184, Hennur Cross, Near: Indian Academy College, Kalyan Nagar, Bengalore-560043

Mobile No: 9741264243 Phone No: 080-42109791 www.panyatech.com

Embedded Systems Design

Introduction to Embedded Systems Design

1. **Trends in Embedded Systems**
2. **Challenges and Design Issues in Embedded Systems**
3. **Assemblers, Compilers, Linkers, Loaders, Debuggers**
4. **Embedded In-Circuit Emulators and JTAG**
5. **Profilers and Test Coverage Tools**
6. **Build Tools for Embedded Systems**
7. **Configuring and Building GNU Cross-Tool chain**

Programming Concepts and Data Communication

1. **C Programming**
2. **OOPS Concepts and C++ Programming**
3. **Data Structures**
4. **Scripting Languages**
5. **Overview of Networking and Packet Switching Concepts**
6. **OSI Reference Model and TCP/IP Protocol Suite**
7. **LAN Protocol Suite**
8. **Application Layer Protocols**
9. **Socket Programming**

Real-Time Operating Systems (RTOS)

1. **Introduction to OS**
2. **Process Management and Inter Process Communication**
3. **Memory management, I/O subsystem, File System Organization**
4. **POSIX Thread Programming**
5. **POSIX Semaphores, Mutexes, Conditional Variables, Barriers, Message Queues**
6. **Debugging and Testing Multi-Threaded Applications**
7. **Introduction to Real-Time / Embedded Operating Systems**
8. **Performance Metrics of RTOS**
9. **Real Time Scheduling, Task Specifications, Schedulability Analysis**
10. **Real Time Linux Internals**
11. **Configuring and Compiling Real Time Linux**
12. **Programming in Real Time Linux**

Embedded Systems Programming

1. **Porting RTOS and Embedded Operating Systems**
2. **Introduction to Boot loaders and Board Support Packages**
3. **Embedded File Systems**
4. **Building RTOS / EOS Image for Target Hardware**
5. **Time, Space and Power aware Programming**
6. **Embedded Linux Kernel Internals**
7. **Embedded Linux Device Drivers**

8/16/32 bit Microcontrollers and Interfacing

1. **Introduction to 8-bit Microcontrollers**
2. **RISC / CISC and Harvard / Princeton Architectures**
3. **Embedded Memory, Timers / Counters, UART, SPI, PWM, WDT**
4. **Input Capture, Output Compare Modes, I2C, CAN**
5. **LED, Switches, ADC, DAC, LCD, RTC**
6. **Emerging Bus Standards (USB, PCI)**
7. **Programming in Assembly and Embedded C**
8. **Introduction to 16 / 32-bit Processors**
9. **ARM Architecture and Organization**
10. **ARM/THUMB Programming Model**
11. **ARM/THUMB Instruction Set**
12. **ARM Exception Handling**
13. **ARM/THUMB Assembly and C Programming (GNU Tools)**
14. **ARM/THUMB Interworking**
15. **ARM Peripheral Programming**
16. **Cortex-M3 Architecture and Programming**
17. **Overview of Multi-Core Embedded Systems**
18. **Overview of FPGA**

Digital Signal Processing

1. Fundamentals of Digital Signal Processing
2. **DFT, IDFT, FFT, Convolution**
3. **FIR and IIR Filter Design**
4. **Algorithm implementation using DSP**
5. **Digital Signal Processor Architecture**
6. **DSP based software development tools**
7. **DSP based embedded system design process**
8. **DSP applications**
9. **Introduction to Codec's**

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ARM CORTEX-M3 SYSTEM DESIGN

PRACTICAL LABS

1. For on-site courses, labs can be run under the following
2. environments : Eclipse/RVDS, Keil µVision, GNU/Lauterbach
3. simulator, or IAR Workbench
4. For open courses, labs are run under Eclipse/RVDS

ARM Cortex-M3

ARM architectural summary

1. Architecture challenge, meeting the challenge with profiles
2. ARM instruction set evolution

ARM Cortex-M3 INTRODUCTION

1. Programmer's model
2. Fixed memory map
3. Privilege, modes and stacks
4. Memory Protection Unit
5. Interrupt handling
6. Nested Vectored Interrupt Controller [NVIC]
7. Power management
8. Debug

DEVELOPMENT TOOLS OVERVIEW

1. RVCT compilation tools
2. Codewarrior for RVDS
3. RVD debugger
4. RVISS simulator
5. JTAG run control unit
6. Trace capture unit

ARM Cortex-M3 CORE

1. Data path and pipeline
2. Write buffer
3. Bit-banding
4. System timer
5. State, privilege and stacks
6. System control bloc

THUMB-2 INSTRUCTION SET

1. Data processing instructions
2. Branch and control flow instructions
3. Memory access instructions
4. Exception generating instructions
5. If…then conditional blocks
6. Exclusive load and store instructions
7. Accessing special registers
8. Memory barriers and synchronization
9. Workbook : introductory tutorial for Cortex-M3

INTERRUPTS

1. Interrupt entry / exit, timing diagrams
2. Tail chaining
3. Interrupt response, pre-emption
4. Interrupt prioritization
5. Interrupt implementation configurability, impact on core size

EXCEPTIONS

1. Exception behavior, exception return
2. Non-maskable exceptions
3. Privilege, modes and stacks
4. Fault escalation
5. Vector table

MEMORY TYPES

1. Memory types, restriction regarding load / store multiple
2. Device and normal memory ordering
3. Access order
4. Memory barriers

MEMORY PROTECTION UNIT

1. Memory protection overview, ARM v7 PMSA
2. Cortex-M3 MPU and bus faults
3. Region overview, memory type and access control, sub-regions

EMBEDDED SOFTWARE DEVELOPMENT WITH Cortex-M3

1. Placing code, data, stack and heap in the memory map,
2. scatter loading
3. Tailoring the C library to your target
4. Reset and initialization
5. Building and debugging your image
6. Long branch veneers
7. Workbook : Retargeting the standard C library functions,
8. handling interrupts

INVASIVE DEBUG

1. Cortex-M3 debug features
2. Monitor mode

3. Flash patch and breakpoint features
4. Data watchpoint and trace
5. DWT registers
6. AHB-Access Port

NON-INVASIVE DEBUG

1. Basic ETM operation
2. ITM stimulus port registers
3. DWT trace packets
4. Time-stamping packets
5. TPIU components
6. Serial Wire connection

C/C++ COMPILER HINTS AND TIPS FOR Cortex-M3

1. ARM compiler optimizations
2. Mixing C/C++ and assembly
3. Coding with ARM compiler
4. Measuring stack usage
5. Local and global data issues, alignment of structures

AMBA3.0 INTERCONNECT SPECIFICATION

1. Purpose of this specification
2. Example of SoC based on AMBA specification
3. Differences between AMBA2.0 and AMBA3.0

AHB - ADVANCED HIGH PERFORMANCE BUS

1. Centralized address decoding
2. Address gating logic
3. Arbitration, bus parking
4. Single-data transactions
5. Sequential transfers
6. Retry response
7. Split response
8. AHB-lite specification

APB - ADVANCED PERIPHERAL BUS

1. Read timing diagram
2. Write timing diagram
3. Operation of the AHB-to-APB bridge
4. APB3.0 new features

AHB CORTEX-M3 HARDWARE IMPLEMENTATION

1. Clocking and reset
2. Bus interfaces , AMBA-3 compliance
3. Debug interface, AHB-AP programming interface, ITM, ETM
4. Connection to the TPIU

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Microcontroller Intel 8051

Introduction

1. Microprocessor vs. Microcontroller
2. CISC vs. RISC

Overview of Architecture of 8051

1. Processor Core and Functional Block Diagram
2. Description of memory organization
3. Overview of ALL SFR's and their basic functionality

Low-level Programming Concepts

1. Addressing Modes
2. Instruction Set and Assembly Language (ALP)
3. Developing, Building and Debugging ALP's

Middle Level Programming Concepts

1. Cross Compiler
2. Embedded C Implementation, prog. * Debugging
3. Differences from ASNSI-C
4. Memory Models
5. Library reference
6. Use of #pragma directive
7. Functions, Parameter passing and return types

On-Chip Peripherals

1. Ports: Input/output
2. Timers & Counters
3. Interrupts, UART

External Interfaces

1. LEDS
2. Switches (Momentary type, Toggle type)
3. Seven Segment Display: (Normal mode, BCD mode,
4. Internal Multiplexing & External Multiplexing)
5. LCD (4bit, 8bit, Busy Flag, Custom Character Generation)
6. Keypad Matrix

Protocols

1. I2C (EEPROM), SPI (EEPROM)

Keil's RTX51 Tiny / Pumpkin's Salvo

1. Overview
2. Specifications
3. Single-Tasking Programs
4. Multi-Tasking Programs
5. RTX51 Tiny Programs
6. Theory of Operation
7. Timer Tick Interrupt
8. Task Management & Scheduler Events
9. Round-Robin & Co-operative Task Switching
10. Idle Task
11. Stack Management
12. Function Reference
13. Porting on to H/W
14. Implementation Examples

Selective Discussion during Project Development

1. A/D & D/A Converter
2. Stepper motor, DC Motor
3. I2C Protocol (RTC:800583,DS1307 ADC:PCF8591, DS1621)
4. SPI Protocols (ADC:MCP3001)
5. IR Communications (Phillips RC5 Protocol)
6. ZIGBEE, GSM, GPS, USB, MMC & SD
7. Ethernet MAC, CAN Protocol

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PIC Controller

Architecture

1. Data Memory
2. Program Memory
3. Status register
4. Working register
5. Ports
6. Option register
7. Configuration bits
8. Reset Vector
9. Interrupt Vector
10. Stack
11. Program Counter
12. Mid-Range Family Members
13. The 16F877
14. Number Systems & Codes
15. Decimal
16. Binary
17. Hex
18. Conversions between systems
19. ASCII Code
20. Grey Code

Segment Code

1. MPLAB-X installation & navigation
   Flash Videos cover the following: Step by Step!
2. Project creation
3. Assembly file editing
4. Debugger operation
5. MPLAB-X Simulator
6. Watch Window operations
7. Stop Watch operation

8. Stack Window operation

Instruction Set

1. Coverage of each instruction with examples
2. Effect of each instruction on Status flags
3. Observing instructions with the Simulator

Assembly Language

1. Basic Assembly Format
2. Assembly Templates
3. Include Files
4. LST Files
5. Hex Files
6. Basic Assembler Directives
7. Basic Macros
8. Basic Assembly parameter conventions
9. Code fragments
10. Subroutines
11. Stack Operation
12. Timing Loops
13. Tuning Timing Loops with the StopWatch

Basic Programming & Algorithms using 7-Segment Displays

1. 7 Segment Displays
2. A simple counter
3. A 2 digit counter
4. A 4 digit counter
5. A Real Time Clock
6. switch input
7. input key debounce
8. keyboard input command menu
9. program design & flow charting
10. step wise refinement & flow charting

LCD programming

1. LCD controller hardware
2. LCD controller commands
3. LCD timing
4. Initializing the controller 4 bit mode
5. Sending Characters to LCD
6. Formatting position for LCD
7. Using the LCD to display Timer, Real Time Clock, conventions, and general text.