

Lesson 12:

Classification and Development Skills Requirements for the Embedded Systems

Small Scale Embedded Systems

Small Scale Embedded Systems

- Designed with a single 8- or 16-bit microcontroller;
- Little hardware and software complexities and involve board-level design.
- Tools for development of embedded software – Editor, assembler and cross assembler, integrated development environment (ISE) specific to the microcontroller or processor used

Small Scale Embedded Systems

- C or Java used for developing
- C program compilation is done into the assembly, and executable codes are then appropriately located in the system memory.
- Software fits within the memory available and keep in view the need to limit power dissipation when system is running continuously

Median Scale Embedded Systems

Median Scale Embedded Systems

- Designed with a single or few 16- or 32-bit microcontrollers or DSPs or Reduced Instruction Set Computers (RISCs).
- Employs the readily available single purpose processors.
- Employ the readily available IPs for the various functions—for example, for the bus interfacing,
- Both hardware and software complexities

Median Scale Embedded Systems

- Programming tools: C/C++/Visual C++/Java, RTOS, and Source code engineering tool, Simulator, Debugger and Integrated Development Environment (IDE). Software tools provide the solutions to the hardware complexities.

Sophisticated Embedded Systems

Sophisticated Embedded Systems

- Enormous hardware and software complexities and may need scalable processors or configurable processors and programmable logic arrays.
- Used for cutting edge applications that need hardware and software co-design and components integration in the final system

Sophisticated Embedded Systems

- Constrained by the processing speeds available in their hardware units.
- Certain software functions such as encryption and deciphering algorithms, discrete cosine transformation and inverse transformation algorithms, TCP/IP protocol stacking and network driver functions implemented in the hardware to obtain additional speeds by saving time

Sophisticated Embedded Systems

- Software implements some of the functions of the hardware resources in the system.
- Development tools for these systems may not be readily available at a reasonable cost or may not be available at all.
- In some cases, a compiler or retargetable compiler might have to be developed for these. [A retargetable compiler is one that configures according to the given target configuration in a system]

Skill for Small Scale Embedded Systems

Skills for Small Scale System

- Full understanding of a microcontroller with a basic knowledge of computer architecture, digital electronic design, software engineering, data communication, control engineering, motors and actuators, sensors and measurements, analog electronic design and IC design and manufacture – Tim Wilmshurst

Skills for Small Scale System

- Specific skills will be needed in specific situations. For example, control engineering knowledge will be needed for design of control systems and analog electronic design knowledge will be needed when designing the system interfaces.

Skills for Small Scale System

- Computer architecture and organization.
- Interfacing the memories.
- Burning the executable machine codes in PROM or ROM.
- Use of decoders and demultiplexers.
- Use of Direct memory accesses.
- Use of Ports and device-drivers.

Skills for Small Scale System

- Device drivers in assembly.
- Simple and sophisticated buses.
- Timers.
- Interrupt servicing mechanism.
- C programming elements.
- Memory optimization.
- Selection of hardware and microcontroller.

Skills for Small Scale System

- Use of ICE (In-Circuit-Emulators), cross-assemblers and testing equipment.
- Debugging the software and hardware bugs by using test vectors.
- Basic knowledge in the other areas—software engineering, data communication, control engineering, motors and actuators, sensors and measurements, analog electronic design and IC design and manufacture

May not need

- All concepts of interrupt latencies and deadlines and their handling the RTOS programming tools.

Skills for Median Scale Embedded Systems

Skills for Median Scale Embedded Systems

- 'C'/C++/Java programming and RTOS programming and program modeling skills
- Programming the Tasks or threads and their scheduling by RTOS.
- Programming priorities and Cooperative and preemptive scheduling.

Skills for Median Scale Embedded Systems

- Use of Inter processor communication functions.
- Use of shared data, and programming the critical sections and re-entrant functions.
- Use of semaphores, mailboxes, queues, sockets and pipes.
- Handling of interrupt-latencies and meeting task deadlines.
- Use of various RTOS functions.
- Use of physical and virtual device drivers.

Skills for Median Scale Embedded Systems

- Designer must have access to an RTOS programming tool with Application Programming Interfaces (APIs) for the specific microcontroller to be used

Skills for Sophisticated Scale Embedded Systems

Skills for Sophisticated Scale Embedded Systems

- Team is needed to co-design and solve the high level complexities of the hardware and software design.

Hardware engineer skills for sophisticated scale embedded systems

- An embedded system hardware engineer should have full skills in hardware units and basic knowledge of 'C'/C++ and Java, RTOS and other programming tools.

Software engineer Skills for Sophisticated Scale Embedded Systems

- Software engineer should have basic knowledge in hardware and a thorough knowledge of 'C', RTOS and other programming tools. A final optimum design solution is then obtained by system integration.

Summary

We learnt

- Classification into three – small scale, median scale and sophisticated systems
- Skill requirements for three classes of systems

End of Lesson 12