Chapter 12

Development Tools for Microcontroller Applications
Lesson 01

Software Development
Process and Development
Tools
Step 1: Development Phases

1. Analysis
   - Phase 1
   - Requirement and specifications

2. Design
   - Phase 2

3. Implementation
   - Phase 3
   - Testing and Debugging

4. Testing and Debugging
   - Phase 4
Phase 1: Analysis

- A listing of the requirements made
- Required system understood and analysed
- Specifications of the application to be developed
Phase 2: Design

• Assume an application (program) consisting of modules or tasks
• A module can be used in multiple parts of an application or in multiple applications or projects
Application contents—modules or tasks, segments, codes, macros, routines (functions) and library routines

Application

Module or task 1

Segment 1

code 1

Routines

New Routines

Module or task m

Segment s1

Macro 1

Library Routines
Module

• A module consists of set of functions.
• The set independent of the results of next module
Task

- A task—a set of instructions
- The set performs some action or a set of actions in a system
- The running of the task controlled by systems software—Operating System (OS) or Real Time Operating System (RTOS)
Appropriate software-development tools for the design

• Firstly the tool selection
• Selection of appropriate modules or tasks, program segments, macros, routines and library routines, and their linkages done.
Selection of hardware for the design

• Based on requirements
• Hardware consists of the microcontroller, memory, needed external interfaces, and expansion circuits
• Selection of an appropriate target platform done for development
Emulator and Target Board

• Use of an emulator circuit for a microcontroller circuit helps in the test phase
• Use of a target board with a monitor– helps in the tests by final high speed run.
Step 2 in Development Phases

Design

Top and bottom levels

modules
macros routines

Segments
Phase 3: Implementation

- Each module or task implemented (coded)
- Coding for the segments
- Statements
- Macros
- Routines
- Appropriate software development tools employed for coding and using the macros and library routines
Step 3 in Development Phases

Implementation

Code Generation          Data

modules

macros          routines          Segments
Phase 4: Testing and Debugging

• A targeted system prototype used during the development phase
• A cycle of the coding for the application codes used
• The cycle consists of design and implementation phases
• The developed codes embedded
• The embedding of machine codes done in the flash memory at the device
• The codes then tested
Cycle of Write, Testing and Debugging and Editing

- The developed codes embedded
- The embedding of machine codes done in the flash memory at the device
- The codes then tested
Write-edit-embed and test cycle
Step A in a software project development processes and development cycle

• A project creation
• The selection of a device (target microcontroller) from a device database
• Then the device configuring
• Then tools set
• Then used in the project
Step A: Project and Application Creation

Project Creation

1. Project Definition

2. Device Selection

3. Device Selection
Step B in a software project development processes and development cycle

- Project file called *source file* created with the help of an editor
  1. in assembly by using an assembler or macro assembler, or
  2. in C by using a compiler, or
  3. in C using an RTOS environment integrated with C compiler in case of a multi-tasking system.
  4. in Visual Basic using an environment integrated with Visual Basic compiler
Step B: Project and Application Creation

Project Creation

- Source File Creation
- Editing
- RTOS
- C
- C compiler
- Assembly
- Assembler/Macro-Assembler
Step C in a software project development processes and development cycle

• Other previously developed source files included in the project
• Project manager– helps in building the application
Step C: Object Files

Project Manager

Including Object Files

Including Object Files
Step D in a software project development processes and development cycle

- Source-file errors corrected
Step D: Object Files

Source Code

Correction of Errors
Step E in a software project development processes and development cycle

- The source and library files linked
- Tested using (i) suitable emulator, or (ii) a suitable debugger/simulator/target debugger using a monitor
Step E: Project and Application Creation

- Library Files
- Object Files
- Linking
- Test and Debug

- Emulator
- Debugger
- Simulator
- Target debugger
Software Development Tool—make facility in IDE

- An IDE provides an integrated development environment
- Managing
- Organising
- Editing
- An integrated *make* facility
Software Development Tool—
Editor in IDE

• Editor used to make assembly or C source file
• Assembler or C compiler used when coding in assembly or C, respectively
• RTOS (internally integrated with the C compiler) used in case of multi-tasking systems and real-time constrained systems
Software Development Tool in IDE

- Source file from the assembler or C compiler
- Linker with a C library using a library manager
- Links all the files from the RTOS or from the assembler, compiler, and library
- The codes locate at the appropriate and distinct addresses
Software Development Tool–Locator in IDE

- Locator creates a hex-file
- Used by a device programmer
- Burns the codes into the target PROM
- Used for program testing using an ICE or an IDE debugger tool
RTOS

Multiple Tasks

Task Synchronisation

Task Scheduling

Inter Process Communication using
signal, semaphores, ...
Summary
We learnt

Software Development Steps

• Analysis
• Design
• Implementation
• Testing and Debugging
• Write Edit Embed and Test cycle
We learnt
Software Development Tools
• Assembler
• Library Manager
• Linker
• Locator
• Debugger/Simulator
• IDE
• RTOS
End of Lesson 01 on

Software Development
Process and Development
Tools