

SD Card Projects Using the PIC Microcontroller

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Dogan Ibrahim



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The Boulevard, Langford Lane, Kidlington, Oxford, OX5 1GB, UK

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Library of Congress Cataloging-in-Publication Data

Ibrahim, Dogan.

SD card projects using the PIC microcontroller / Dogan Ibrahim.

p. cm.

Includes bibliographical references and index.

ISBN 978-1-85617-719-1 (alk. paper)

1. Microcontrollers—Programming. 2. Programmable controllers. 3. Computer storage devices. I. Title. TJ223.P76.I275 2010

004.16—dc22

2009041498

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

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Printed in the United States of America

10 11 12 9 8 7 6 5 4 3 2 1

Typeset by: diacriTech, Chennai, India

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Thanks is due to Microchip Ltd for their technical support and permission to include MPLAB IDE, MDD library, and Student Version of the MPLAB C18 compiler on the Web site that accompanies this book.

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Contents

<i>Preface</i>	<i>xix</i>
<i>About the Web Site</i>	<i>xxiii</i>
Chapter 1: Microcontroller Systems	1
1.1 Introduction	1
1.2 Microcontroller Systems	1
1.2.1 Random Access Memory	4
1.2.2 Read Only Memory	5
1.2.3 Programmable Read Only Memory	5
1.2.4 Erasable Programmable Read Only Memory.....	5
1.2.5 Electrically Erasable Programmable Read Only Memory	5
1.2.6 Flash EEPROM	6
1.3 Microcontroller Features	6
1.3.1 Buses	6
1.3.2 Supply Voltage	6
1.3.3 The Clock	7
1.3.4 Timers.....	7
1.3.5 Watchdog.....	7
1.3.6 Reset Input.....	8
1.3.7 Interrupts	8
1.3.8 Brown-Out Detector	8
1.3.9 A/D Converter	8
1.3.10 Serial I/O	9
1.3.11 EEPROM Data Memory.....	9
1.3.12 LCD Drivers	10
1.3.13 Analog Comparator	10
1.3.14 Real-Time Clock	10
1.3.15 Sleep Mode.....	10
1.3.16 Power-on Reset.....	10
1.3.17 Low-Power Operation	10
1.3.18 Current Sink/Source Capability	11
1.3.19 USB Interface	11
1.3.20 Motor Control Interface.....	11

1.3.21 Controller Area Network Interface.....	11
1.3.22 Ethernet Interface	11
1.3.23 ZigBee Interface	11
1.4 Microcontroller Architectures	11
1.4.1 Reduced Instruction Set Computer and Complex Instruction Set Computer.....	12
1.5 Choosing a PIC Microcontroller	12
1.6 Number Systems.....	13
1.6.1 Decimal Number System	13
1.6.2 Binary Number System	13
1.6.3 Octal Number System	14
1.6.4 Hexadecimal Number System.....	14
1.7 Converting Binary Numbers into Decimal.....	14
1.8 Converting Decimal Numbers into Binary.....	16
1.9 Converting Binary Numbers into Hexadecimal	18
1.10 Converting Hexadecimal Numbers into Binary	19
1.11 Converting Hexadecimal Numbers into Decimal.....	20
1.12 Converting Decimal Numbers into Hexadecimal.....	21
1.13 Converting Octal Numbers into Decimal	21
1.14 Converting Decimal Numbers into Octal	22
1.15 Converting Octal Numbers into Binary.....	24
1.16 Converting Binary Numbers into Octal.....	24
1.17 Negative Numbers	25
1.18 Adding Binary Numbers	26
1.19 Subtracting Binary Numbers	27
1.20 Multiplication of Binary Numbers	28
1.21 Division of Binary Numbers	29
1.22 Floating Point Numbers.....	30
1.23 Converting a Floating Point Number into Decimal.....	31
1.23.1 Normalizing the Floating Point Numbers	32
1.23.2 Converting a Decimal Number into Floating Point.....	33
1.23.3 Multiplication and Division of Floating Point Numbers.....	34
1.23.4 Addition and Subtraction of Floating Point Numbers.....	35
1.24 Binary-Coded Decimal Numbers	36
1.25 Summary	38
1.26 Exercises.....	38
Chapter 2: PIC18F Microcontroller Series.....	41
2.1 PIC18FXX2 Architecture.....	44
2.1.1 Program Memory Organization.....	47
2.1.2 Data Memory Organization.....	49
2.1.3 The Configuration Registers.....	49
2.1.4 The Power Supply	50
2.1.5 The Reset.....	53

2.1.6	The Clock Sources	57
2.1.7	Watchdog Timer	62
2.1.8	Parallel I/O Ports	63
2.1.9	Timers	69
2.1.10	Capture/Compare/PWM Modules	77
2.1.11	Pulse Width Modulation Module	80
2.1.12	Analog-to-Digital Converter Module	84
2.1.13	Interrupts	91
2.2	Summary	103
2.3	Exercises	103
Chapter 3: Memory Cards		107
3.1	Memory Card Types	107
3.2	Smart Media Card	108
3.3	Multimedia Card	109
3.4	Compact Flash Card	110
3.5	Memory Stick Card	111
3.6	Microdrive	112
3.7	xD Card	112
3.8	Secure Digital Card	113
3.8.1	Standard SD Cards	113
3.8.2	High-Capacity SD Cards	115
3.9	Memory Card Readers	116
3.10	Memory Card Physical Properties	117
3.11	Memory Card Technical Properties	117
3.12	Detailed SD Card Structure	118
3.12.1	SD Card Pin Configuration	118
3.12.2	SD Card Interface	119
3.13	SD Card Internal Registers	122
3.13.1	OCR Register	123
3.13.2	CID Register	123
3.13.3	CSD Register	125
3.13.4	RCA Register	130
3.13.5	DSR Register	130
3.13.6	SCR Register	131
3.13.7	SD Status Register	131
3.14	Calculating the SD Card Capacity	131
3.15	SD Card SPI Bus Protocol	132
3.15.1	Data Read	132
3.15.2	Data Write	132
3.15.3	Response Tokens	133
3.16	Data Tokens	134
3.17	Card Reset State	135
3.18	Summary	135
3.19	Exercises	136

Chapter 4: Programming with the MPLAB C18 Compiler	137
4.1 C Programming Languages for PIC18 Microcontrollers	137
4.2 MPLAB C18 Compiler	138
4.2.1 Installing the MPLAB C18 Compiler	138
4.3 An Example Program	143
4.3.1 Building the Project.....	143
4.3.2 Simulating the Project	147
4.4 Flashing LED Example	150
4.4.1 Building and Simulating the Project	150
4.5 Structure of the MPLAB C18 Compiler.....	152
4.5.1 Comments.....	152
4.5.2 Terminating Program Statements	154
4.5.3 White Spaces	154
4.5.4 Case Sensitivity	154
4.5.5 Variable Names	155
4.5.6 Variable Types	155
4.5.7 Constants	157
4.5.8 Escape Sequences.....	159
4.5.9 Static Variables	160
4.5.10 External Variables	160
4.5.11 Volatile Variables.....	160
4.5.12 Enumerated Variables.....	160
4.5.13 Arrays	161
4.5.14 Pointers.....	162
4.5.15 Structures.....	164
4.5.16 Unions	167
4.5.17 Operators in C	168
4.5.18 Modifying the Flow of Control	178
4.5.19 Iteration Statements.....	181
4.5.20 Mixing C18 with Assembly Language Statements	187
4.6 PIC Microcontroller I/O Port Programming	188
4.7 Programming Examples	189
4.8 Functions	193
4.8.1 Function Prototypes.....	198
4.8.2 Passing Arrays to Functions	199
4.8.3 Passing Variables by Reference to Functions.....	204
4.8.4 Static Function Variables.....	204
4.9 MPLAB C18 Library Functions.....	206
4.9.1 Delay Functions.....	207
4.9.2 Character Classification Functions	211
4.9.3 Data Conversion Functions	213
4.9.4 Memory and String Manipulation Functions	213
4.9.5 Reset Functions	216
4.9.6 Character Output Functions	218

4.9.7	Math Library Functions.....	222
4.9.8	LCD Functions	225
4.9.9	Software CAN2510 Functions	239
4.9.10	Software I ² C Bus Functions	239
4.9.11	Software SPI Bus Functions.....	239
4.9.12	Software UART Functions	239
4.9.13	Hardware Analog-to-Digital (A/D) Converter Functions	245
4.9.14	Hardware Input Capture Functions	247
4.9.15	Hardware I ² C Functions	247
4.9.16	Hardware I/O Port Functions	247
4.9.17	Hardware Microwire Functions.....	247
4.9.18	Hardware Pulse Width Modulation Functions	247
4.9.19	Hardware SPI Functions.....	248
4.9.20	Hardware Timer Functions.....	248
4.9.21	Hardware USART Functions.....	249
4.10	Summary	252
4.11	Exercises.....	253
Chapter 5: PIC18 Microcontroller Development Tools		257
5.1	Software Development Tools	257
5.1.1	Text Editors	258
5.1.2	Assemblers and Compilers.....	258
5.1.3	Simulators.....	259
5.1.4	High-Level Language Simulators.....	259
5.1.5	Integrated Development Environments	260
5.2	Hardware Development Tools	260
5.2.1	Development Boards	260
5.2.2	Device Programmers	274
5.2.3	In-Circuit Debuggers.....	276
5.2.4	In-Circuit Emulators.....	280
5.2.5	Breadboards.....	283
5.3	Using the MPLAB ICD 3 In-Circuit Debugger	285
5.3.1	The Debugging Process.....	288
5.3.2	The MPLAB ICD 3 Test Interface Board	289
5.3.3	Programming with the MPLAB ICD 3 Debugger.....	289
5.3.4	MPLAB ICD 3 Debugging Example I.....	292
5.3.5	MPLAB ICD 3 Debugging Example II.....	293
5.3.6	MPLAB ICD 3 Debugging Example III	294
5.4	Summary	296
5.5	Exercises.....	296
Chapter 6: PIC18 Microcontroller MPLAB C18-Based Simple Projects		299
6.1	Program Description Language.....	299
6.1.1	START-END.....	300
6.1.2	Sequencing	300

6.1.3	IF-THEN-ELSE-ENDIF	301
6.1.4	DO-ENDDO	301
6.1.5	REPEAT-UNTIL	303
6.2	Project 1 – Chasing LEDs	304
6.2.1	Project Description	304
6.2.2	Project Hardware	305
6.2.3	Project PDL	306
6.2.4	Project Program	306
6.2.5	Further Development	306
6.3	Project 2 – LED Dice	308
6.3.1	Project Description	308
6.3.2	Project Hardware	308
6.3.3	Project PDL	310
6.3.4	Project Program	310
6.3.5	Using a Pseudorandom Number Generator	311
6.4	Project 3 – Two-Dice Project	314
6.4.1	Project Description	314
6.4.2	Project Hardware	315
6.4.3	Project PDL	316
6.4.4	Project Program	316
6.5	Project 4 – Two Dice Project – Fewer I/O Pins	318
6.5.1	Project Description	318
6.5.2	Project Hardware	319
6.5.3	Project PDL	321
6.5.4	Project Program	321
6.5.5	Modifying the Program	322
6.6	Project 5 – Seven-Segment LED Counter	326
6.6.1	Project Description	326
6.6.2	Project Hardware	328
6.6.3	Project PDL	330
6.6.4	Project Program	330
6.6.5	Modified Program	332
6.7	Project 6 – Two-Digit Multiplexed Seven-Segment LED	333
6.7.1	Project Description	333
6.7.2	Project Hardware	335
6.7.3	Project PDL	335
6.7.4	Project Program	337
6.8	Project 7 – Two-Digit Multiplexed Seven-Segment LED Counter With Timer Interrupt	338
6.8.1	Project Description	338
6.8.2	Project Hardware	341
6.8.3	Project PDL	341
6.8.4	Project Program	341
6.8.5	Modifying the Program	345

6.9 Project 8 – Four-Digit Multiplexed Seven-Segment LED Counter With Timer Interrupt	347
6.9.1 Project Description	347
6.9.2 Project Hardware	347
6.9.3 Project PDL	348
6.9.4 Project Program	348
6.9.5 Modifying the Program	352
6.9.6 Using MPLAB C18 Compiler Timer Library Routines	352
6.10 Summary	359
6.11 Exercises	359
Chapter 7: Serial Peripheral Interface Bus Operation	361
7.1 The Master Synchronous Serial Port Module	361
7.2 MSSP in SPI Mode	361
7.3 SPI Mode Registers	362
7.3.1 SSPSTAT	363
7.3.2 SSPCON1	364
7.4 Operation in SPI Mode	365
7.4.1 Configuration of MSSP for SPI Master Mode	365
7.5 SPI Bus MPLAB C18 Library Functions	367
7.5.1 CloseSPI	368
7.5.2 DataRdySPI	368
7.5.3 getcSPI	368
7.5.4 getsSPI	368
7.5.5 OpenSPI	368
7.5.6 putcSPI	369
7.5.7 putsSPI	369
7.5.8 ReadSPI	369
7.5.9 WriteSPI	369
7.6 Example of an SPI Bus Project	369
7.6.1 TC72 Temperature Sensor	370
7.6.2 The Circuit Diagram	374
7.6.3 The Program	374
7.6.4 Displaying Negative Temperatures	381
7.6.5 Displaying the Fractional Part	382
7.7 Summary	393
7.8 Exercises	393
Chapter 8: MPLAB C18 SD Card Functions and Procedures	395
8.1 Installation of the MDD Library	395
8.2 MDD Library Functions	396
8.2.1 File and Disk Manipulation Functions	396
8.2.2 Library Options	396
8.2.3 Memory Usage	398
8.2.4 Library Setup	399

8.3	Sequence of Function Calls.....	400
8.3.1	Reading from an Existing File	400
8.3.2	Writing Onto an Existing File	401
8.3.3	Deleting an Existing File.....	401
8.4	Detailed Function Calls	401
8.4.1	FSInit.....	401
8.4.2	FSfopen	402
8.4.3	FSfopenpgm	402
8.4.4	FSfclose.....	403
8.4.5	FSfeof.....	403
8.4.6	FSfread	404
8.4.7	FSfwrite.....	404
8.4.8	FSremove.....	405
8.4.9	FSremovepgm	405
8.4.10	FSrewind	405
8.4.11	FSmkdir.....	405
8.4.12	FSrmdir.....	406
8.4.13	FSchdir	406
8.4.14	FSformat.....	407
8.4.15	FSrename.....	407
8.4.16	FindFirst	408
8.4.17	FindFirstpgm	409
8.4.18	FindNext.....	410
8.4.19	SetClockVars	410
8.4.20	FSprintf	410
8.5	Summary	411
8.6	Exercises.....	411

Chapter 9: Secure Digital Card Projects..... 413

9.1	Creating an MPLAB C18 Template	417
9.1.1	Setting the Configuration Files.....	424
9.1.2	The Memory Model	426
9.2	PROJECT 1 – Writing a Short Text Message to an SD Card.....	427
9.2.1	Description	427
9.2.2	Aim.....	427
9.2.3	Block Diagram	428
9.2.4	Circuit Diagram.....	428
9.2.5	Operation of the Project	429
9.2.6	Program Code.....	429
9.2.7	Description of the Program Code.....	430
9.2.8	Suggestions for Future Work.....	433
9.3	PROJECT 2 – Time Stamping a File.....	433
9.3.1	Description	433
9.3.2	Aim.....	434
9.3.3	Block Diagram	434

9.3.4	Circuit Diagram.....	434
9.3.5	Operation of the Project	434
9.3.6	Program Code.....	434
9.3.7	Description of the Program Code.....	434
9.3.8	Suggestions for Future Work.....	434
9.4	PROJECT 3 – Formatting a Card.....	436
9.4.1	Description	436
9.4.2	Aim.....	436
9.4.3	Block Diagram	437
9.4.4	Circuit Diagram.....	437
9.4.5	Operation of the Project	437
9.4.6	Program Code.....	437
9.4.7	Description of the Program Code.....	438
9.4.8	Suggestions for Future Work.....	438
9.5	PROJECT 4 – Deleting a File	439
9.5.1	Description	439
9.5.2	Aim.....	439
9.5.3	Block Diagram	439
9.5.4	Circuit Diagram.....	439
9.5.5	Operation of the Project	439
9.5.6	Program Code.....	439
9.5.7	Description of the Program Code.....	439
9.5.8	Suggestions for Future Work.....	441
9.6	PROJECT 5 – Renaming a File.....	441
9.6.1	Description	441
9.6.2	Aim.....	441
9.6.3	Block Diagram	441
9.6.4	Circuit Diagram.....	441
9.6.5	Operation of the Project	441
9.6.6	Program Code.....	442
9.6.7	Description of the Program Code.....	442
9.6.8	Suggestions for Future Work.....	443
9.7	PROJECT 6 – Creating a Directory	443
9.7.1	Description	443
9.7.2	Aim.....	444
9.7.3	Block Diagram	444
9.7.4	Circuit Diagram.....	444
9.7.5	Operation of the Project	444
9.7.6	Program Code.....	444
9.7.7	Description of the Program Code.....	444
9.7.8	Suggestions for Future Work.....	444
9.8	PROJECT 7 – Create a Directory and a File.....	446
9.8.1	Description	446
9.8.2	Aim.....	446
9.8.3	Block Diagram	446

9.8.4	Circuit Diagram.....	446
9.8.5	Operation of the Project	446
9.8.6	Program Code.....	446
9.8.7	Description of the Program Code.....	446
9.8.8	Suggestions for Future Work.....	448
9.9	PROJECT 8 – File Copying	448
9.9.1	Description	448
9.9.2	Aim.....	448
9.9.3	Block Diagram	449
9.9.4	Circuit Diagram.....	449
9.9.5	Operation of the Project	449
9.9.6	Program Code.....	449
9.9.7	Description of the Program Code.....	449
9.9.8	Suggestions for Future Work.....	449
9.10	PROJECT 9 – Displaying File on a PC.....	451
9.10.1	Description	451
9.10.2	Aim.....	451
9.10.3	Block Diagram	451
9.10.4	Circuit Diagram.....	452
9.10.5	Operation of the Project	453
9.10.6	The Program Code	453
9.10.7	Description of the Program Code.....	453
9.10.8	Suggestions for Future Work.....	457
9.11	PROJECT 10 – Reading a Filename from the PC and Displaying the File	458
9.11.1	Description	458
9.11.2	Aim.....	459
9.11.3	Block Diagram	459
9.11.4	Circuit Diagram.....	459
9.11.5	Operation of the Project	459
9.11.6	Program Code.....	459
9.11.7	Description of the Program Code.....	459
9.11.8	Suggestions for Future Work.....	463
9.12	PROJECT 11 – Looking for a File	463
9.12.1	Description	463
9.12.2	Aim.....	463
9.12.3	Block Diagram	463
9.12.4	Circuit Diagram.....	463
9.12.5	Operation of the Project	463
9.12.6	Program Code.....	464
9.12.7	Description of the Program Code.....	464
9.12.8	Suggestions for Future Work.....	467
9.13	PROJECT 12 – Looking for a Number of Files with a Given File Extension	467
9.13.1	Description	467
9.13.2	Aim.....	467
9.13.3	Block Diagram	468

9.13.4	Circuit Diagram.....	468
9.13.5	Operation of the Project	468
9.13.6	Program Code.....	468
9.13.7	Description of the Program Code.....	468
9.13.8	Suggestions for Future Work.....	472
9.14	PROJECT 13 – Displaying the Attributes of a File.....	472
9.14.1	Description	472
9.14.2	Aim.....	473
9.14.3	Block Diagram	473
9.14.4	Circuit Diagram.....	473
9.14.5	Operation of the Project	473
9.14.6	Program Code.....	473
9.14.7	Description of the Program Code.....	473
9.14.8	Suggestions for Future Work.....	477
9.15	PROJECT 14 – SD Card File Handling	477
9.15.1	Description	477
9.15.2	Aim.....	478
9.15.3	Block Diagram	478
9.15.4	Circuit Diagram.....	478
9.15.5	Operation of the Project	478
9.15.6	Program Code.....	478
9.15.7	Description of the Program Code.....	478
9.15.8	Suggestions for Future Work.....	488
9.16	PROJECT 15 – MENU-Based SD Card File Handling	490
9.16.1	Description	490
9.16.2	Aim.....	490
9.16.3	Block Diagram	490
9.16.4	Circuit Diagram.....	490
9.16.5	Operation of the Project	490
9.16.6	Program Code.....	491
9.16.7	Description of the Program Code.....	491
9.16.8	Suggestions for Future Work.....	502
9.17	PROJECT 16 – Digital Data Logging to SD card.....	502
9.17.1	Description	502
9.17.2	Aim.....	503
9.17.3	Block Diagram	503
9.17.4	Circuit Diagram.....	503
9.17.5	Operation of the Project	503
9.17.6	Program Code.....	503
9.17.7	Description of the Program Code.....	503
9.17.8	Suggestions for Future Work.....	504
9.18	PROJECT 17 – Temperature Data Logging	507
9.18.1	Description	507
9.18.2	Aim.....	507
9.18.3	Block Diagram	507

9.18.4	Circuit Diagram.....	507
9.18.5	Operation of the Project	509
9.18.6	Program Code.....	509
9.18.7	Description of the Program Code.....	509
9.18.8	Suggestions for Future Work.....	515
9.19	PROJECT 18 – Temperature and Pressure Data Logging with Real-Time Clock	515
9.19.1	Description	515
9.19.2	Aim.....	515
9.19.3	Block Diagram	515
9.19.4	Circuit Diagram.....	516
9.19.5	Operation of the Project	516
9.19.6	Program Code.....	516
9.19.7	Description of the Program Code.....	516
9.19.8	Suggestions for Future Work.....	529
	Appendix A–MC33269 Data Sheet	531
	Appendix B–MAX232 Data Sheet	533
	Appendix C–LM35 Data Sheet.....	535
	Appendix D–MPX4115A Data Sheet.....	537
	Index.....	539

Preface

A microcontroller is a single-chip microprocessor system that contains data and program memory, serial and parallel input–output, timers, and external and internal interrupts, all integrated into a single chip that can be purchased for as little as \$2.00. Approximately 40% of microcontroller applications are in office automation, such as PCs, laser printers, fax machines, intelligent telephones, and so forth. Approximately one-third of microcontrollers are found in consumer electronic goods. Products like CD players, hi-fi equipment, video games, washing machines, cookers, etc., fall into this category. The communications market, automotive market, and military share the rest of the application areas.

Flash memory cards are high-capacity nonvolatile read-write type semiconductor memories used in many domestic, commercial, and industrial applications. For example, portable electronic devices like digital cameras, video recorders, MP3 players, GPS receivers, laptop computers, and many more domestic and office products use some form of flash memory cards. Currently, there are many types of flash memory cards. Some of the popular cards are secure digital (SD) card, compact flash card, memory stick card, smart media card, and so on.

This book is about SD memory cards; it gives the basic working theory of the cards and describes how they can be used in PIC microcontroller-based electronic projects. Eighteen fully tested and working projects are given in the book to show how SD cards can be used for storing large amounts of data.

This book has been written with the assumption that the reader has taken a course on digital logic design and has been exposed to writing programs using at least one high-level programming language. Knowledge of the C programming language will be useful. In addition, familiarity with at least one member of the PIC16F series of microcontrollers will be an advantage. Knowledge of assembly language programming is not required because all the projects in the book are based on C language.

Chapter 1 presents the basic features of microcontroller systems. It also introduces the important topic of number systems and describes how to convert a given number from one base into another base.

Chapter 2 provides a review of the PIC18F series of microcontrollers. The various features of these microcontrollers are described in detail.

Chapter 3 provides brief details about commonly used memory cards. SD cards are currently the most widely used memory cards. The technical details and communication methods of these cards are described in the chapter.

Chapter 4 begins with a short tutorial on C language and then examines the features of the MPLAB C18 compiler used in all of the projects in this book. A fully working student version of the compiler is also given on the Web site that accompanies this book.

Chapter 4 also covers the advanced features of the MPLAB C18 language. Topics like built-in functions, simulators, and libraries are discussed, along with working examples.

Chapter 5 explores the various software and hardware development tools for the PIC18 series of microcontrollers and gives examples of various commercially available development kits. In addition, development tools like simulators, emulators, and in-circuit debuggers are described, with examples.

Chapter 6 provides some simple projects using the PIC18 series of microcontrollers and the MPLAB C18 language compiler. All the projects in the chapter are based on the PIC18F series of microcontrollers, and all the projects have been tested and are working. The chapter should be useful for those who are new to PIC microcontrollers and for those who want to extend their knowledge of programming the PIC18F series of microcontrollers using the MPLAB C18 compiler.

Chapter 7 is about the PIC microcontroller SPI bus interface. SD cards are usually used in SPI bus mode, and this chapter should provide an invaluable introduction to the SPI bus and its programming using the MPLAB C18 compiler.

In this book, the Microchip SD card function library, known as the memory disk drive (MDD) library, is used in all SD card–based projects. Chapter 8 gives the details of the MDD functions and describes how they can be used in projects to create files on the SD card and how to read and write these files.

Chapter 9 provides 18 working and fully tested SD card–based microcontroller projects. The block diagram, circuit diagram, full program listing, and description of each program are given for each project. The projects include simple topics like creating files on an SD card, formatting a card, and reading and writing to the card. In addition, SD card–based complex data-logging projects are given, where ambient temperature and pressure are read and stored on the SD card with real-time stamping. The data can then be exported into a spreadsheet program, such as Excel, and the change in the temperature or pressure can be analyzed statistically or plotted against time.

The Web site accompanying this book contains all the program source files and HEX files of the projects described in the book. In addition, a copy of the student version of MPLAB C18 compiler is included on the Web site.

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September, 2009

About the Web Site

The Web site accompanying this book contains the following folders and files:

MPLAB IDE:	MPLAB IDE software package
C18:	Student version of the MPLAB C18 compiler
MDD:	Microchip MDD File I/O System Library
FIGURES:	Figures used in this book (.TIFF and .JPG)
FIGURES-BMP:	Figures used in this book (.BMP)
TABLES:	Tables used in this book
PROGRAMS:	A list of programs used in this book (.C and .HEX)
DRAWINGS:	Circuit diagrams used in this book (.DSN)