SD Card Projects Using the PIC Microcontroller

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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.

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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Contents

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.

Prof. Dr. Dogan Ibrahim
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)