

Preface

Our world is full of smart and connected products embedded with processors, sensors, and software. Do-it-yourself communities have always been fascinated by the fact that a person can design and build his/her own smart system for specific tasks. Arduino presents us with an alternative platform to build such amazing products. Users can download the Arduino Integrated Development Environment (IDE) and code their own program using the C/C++ language as well as the Arduino Core library, which provides a considerable amount of helpful functions and features. Arduino makes it easy to sense and respond to touch, sound, position, heat, light, etc.

The SPIED (Summer Program for Innovative Engineering Design) has been implemented in three countries, i.e., Japan, China, and Korea, on a rotation basis since 2013. The role of SPIED is to establish innovative engineering education in the three countries. In the SPIED, senior-level and graduate students from Japan, China, and Korea stay and work together on planning, designing, production, and presentation of a prototype mechatronics and robotic system. By combining engineering design technique with the ability to identify problems from a multidisciplinary perspective, SPIED provides participants with a sense of achievement when they undergo the process of drawing their dreams as a concept, followed by designing and creating them as prototypes. However, mechatronics and robotic systems involve numerous techniques related to multiple disciplines. Students need to spend a considerable amount of time learning technologies. A unique advantage of Arduino is that it can be used by anyone, even people with no programming or electronics experience. Arduino is an open-source platform composed of very simple and easy-to-use hardware and software, which has mainly been developed for prototyping purposes. Therefore, it is a great fit for students.

In this book, we want to systematically integrate Arduino modules with Arduino platform and train beginners in understanding this technology. Furthermore, information on various topics including sensors, optics, electronics, mechatronics, mathematical calculations, etc. is also introduced in this book, which can help readers explore system development from an interdisciplinary perspective.

Objective and Intended Audience

The purpose of this book is to present programming and electronics techniques based on Arduino and to discuss them from the point of view of using micro controller technology to interact with the environment. Over the last three years, notes based on this book have been used to support the Summer Program for Innovative Engineering Design (SPIED), which has been implemented by three countries, Japan, China, and Korea, on a rotation basis (<http://ire-asia.org/ire/spied/>). The book can also be used in senior-level/first-year-graduate courses on micro-controllers and its applications. Portions of these notes have been used to support training courses for electronics makers and hobbyist.

Book Contents

Although this is a book on open-source hardware and electronics, you will find a number of code examples. They are used to configure the hardware as desired and make it do what we want it to do. The authors are a professional teacher with a good experience in Embedding System Design. Through our partnership, we try to show a model of how traditional education can merge with the makers of the world to create a much richer learning experience than is possible to have by learning passively. Chapters 1–6 are written by Prof. Tianhong Pan, and Chaps. 7 and 8 are written by Biqi Sheng Ph.D. and Prof. Yi Zhu respectively.

The book begins (Chap. 1) by pointing out the different variants of Arduino boards. Next, Arduino history and characteristics are quickly reviewed, and the driver installation procedure and IDE of Arduino are also introduced.

Chapter 2 describes many embedded basic functions, such as the functions for reading and writing digital and analog input and output pins, interrupt functions, mathematic functions, and serial communication functions.

Chapter 3 presents the various types of sensor modules available for Arduino. It covers many of the commonly available types, such as the temperature sensor, joystick module, analogy sound sensor, and other items that are not specific to Arduino, but are compatible. Electrical pin-out information, schematics, and software are provided for many of the items discussed.

Chapter 4 explains how you can make things move by controlling motors with Arduino. A wide range of motor types are covered: DC motor, servo, stepper motor. All kinds of driving circuits and their schematics are introduced in this chapter.

Chapter 5 focuses on wireless techniques such as: infrared transmitter/receiver Bluetooth, ZigBee, Wi-Fi, etc. The examples in this chapter demonstrate how to connect Arduino to devices and modules and realize remote control.

Chapters 6–8 cover some projects that illustrate the capabilities of Arduino boards and sensor modules. They are intended to demonstrate how Arduino can be applied in various situations. Each example description includes theory of operation, schematics, detailed parts lists, layouts, and an overview of the software necessary for it to function.

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