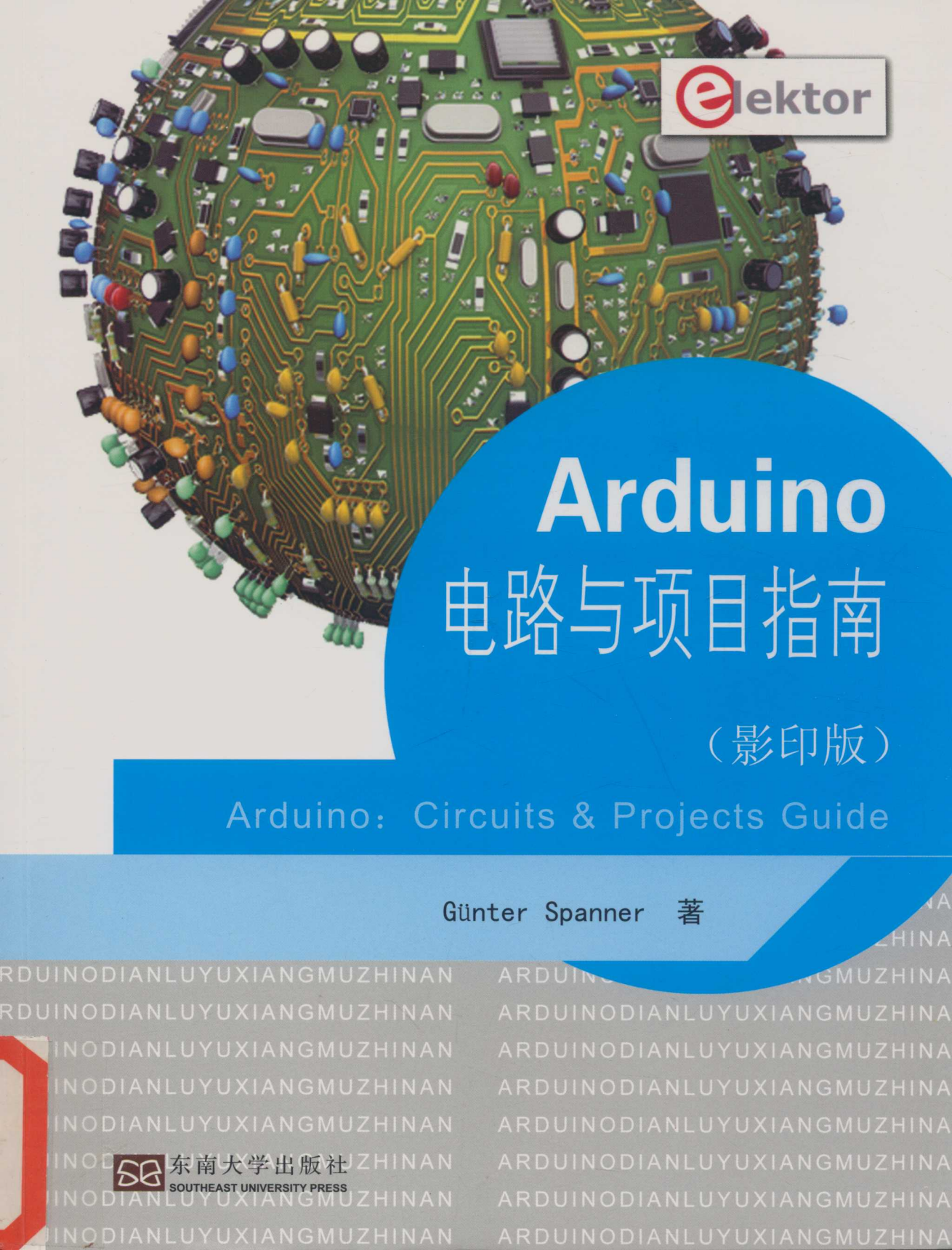




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Arduino

电路与项目指南

(影印版)

Arduino: Circuits & Projects Guide

Günter Spanner 著



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About the Author

The author of this book has been active for 16 years in research and development.

The main focus of his work for various major companies, such as Siemens and ABB, is Project Management in the areas of electronic development and physical technology.

Under his leadership and cooperation, several universities have received patents in various fields, from the electronics in environmental sensors to bio- and medical technology.

Thanks to his involvement in the fields of Sourcing Engineering and as Technology and Category Manager, he has detailed knowledge of the semiconductor market and production technology.

Besides his work as a specialist lecturer in physics and electrical engineering, he has published several articles and books on the topics of electronics, semiconductors and microcontrollers, and has created courses and tuition packages on these topics.

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1

Introduction

There are two main reasons for Arduino's success. The first is the complete processor board, which has significantly eased entry into the microcontroller hardware arena. Typical beginner problems, such as bad power supplies, problems with setting the configuration parameters (fuse bits) and crystals that won't oscillate due to bad load capacitances are all foreign to the Arduino world. The board is simply connected to a PC's USB port, and off we go. People young and old who've never been involved in electronics won't have any difficulty.

The second success factor is the associated programming interface, which is provided as free-of-charge open source software. The second success factor is the associated programming interface, which is provided as free-of-charge open source software. In addition, installation is quick and easy, so the environment is usable immediately. Simple introductory examples encourage rapid progress. The selection of complicated parameters is not required, and the first example programs may be opened and run within minutes.

Furthermore, the Arduino is backed up with a wealth of software libraries, and the number of which grows daily, often presenting beginners with their first problem: after the introduction of simple examples, the way forward is not clear. This is often due to the lack of detailed descriptions and explanations. The number of projects on the internet, which are explained to a greater or lesser extent, is more likely to cause confusion. Because these applications are designed by a number of different people, each with their own goals in mind, there is no common thread connecting them.

That's where this book comes in. Projects are introduced systematically, each introducing a different theme. A practical hands-on approach is employed alongside the necessary theoretical foundations and, in a similar vein, important concepts such as A/D conversion, timers and interrupts are presented using practical projects. There are running lights, fully-functional voltmeters, precise digital thermometers, clocks of all kinds, reaction timers and a mouse-controlled robot crane. Along the way, the reader will gain an understanding of the associated controller techniques and pick them up fully — in the truest sense of the word.

The practical projects presented herein will not be relegated to the status of mere 'laboratory prototypes'. By means of appropriate hints and notes, other practical devices will arise, which may be used for home, hobby and work. The projects are always implemented using easy-to-find and inexpensive components.

In the final chapter, an Arduino-based 'Living Room Box' is presented. It is designed modularly and may be adapted to individual requirements. The knowledge gleaned throughout the book is used practically to produce a very useful, yet unusual, device.

1.1 The Arduino Project

The Arduino concept came to be in 2005 at the Institute for Interactive Design in Ivrea, Italy. The search for a low-cost microcontroller system for design students led to a handy printed circuit board that contained all of the necessary electronic building blocks. The main objective was the development of an inexpensive microcontroller board that could be utilized quickly and simply by art and design students who had no previous knowledge of programming or electronics.

The first version of the Arduino hardware consisted of a kit that could be soldered together easily, and it sold out quickly. Newer versions followed in rapid succession. Designers and artists from other regions took up the idea and the Arduino principle spread, first in Italy, then into Europe, and eventually to the rest of the world.

Interest grew rapidly in application areas outside of art academies and design schools. The concept of a simple and low-cost hardware platform with a freely available, easy-to-learn programming language was quickly embraced by hobbyists. Finally, schools and universities in the scientific and technical fields recognized the enormous potential of the Arduino idea. New hardware versions, as well as plug-in expansion boards, or 'shields', arose, and Arduino application areas were limited only by users' imaginations.

Meanwhile, the number of Arduinos shipped has exceeded the 100,000 mark by far. If DIY versions and clones are considered as well, the actual figure may exceed 1 million. It is, therefore, no exaggeration to claim that the Arduino microcontroller board is the most successful of all time.

1.2 Book Structure and Target Audience

This book is aimed at those who've already had some basic experience in the electronics field. The typical high school lessons on circuits, Ohm's law, etc., are fully sufficient. In Chapter 4, the basic functions and characteristics of the major components are explained. In due course, more elaborate projects are discussed, so that even students and teachers who come with some pre-existing technical knowledge will encounter new challenges.

The projects are grouped into individual themes. However, care was taken to place the less technically challenging material at the beginning of the book. For this reason, beginners will find it helpful to go through the book's chapters in order, even if not every single project is constructed.

2

Structure and Function of the Hardware

In its original form, the Arduino board was fitted with an ATmega8 microcontroller and a simple RS-232 level converter. In this way, it could be programmed directly from a PC's serial port. Over time, a variety of updates and versions has evolved from this prototype. Since fewer and fewer PCs came equipped with this legacy interface over the years, one of the first major steps in Arduino development was the addition of a USB-to-RS-232 converter. At first, an FTDI chip was used. Later, on the Arduino UNO board, this relatively expensive chip was replaced by an ATmega8U2. Using suitable firmware, this chip is able to manage USB-to-RS-232 protocol conversion.

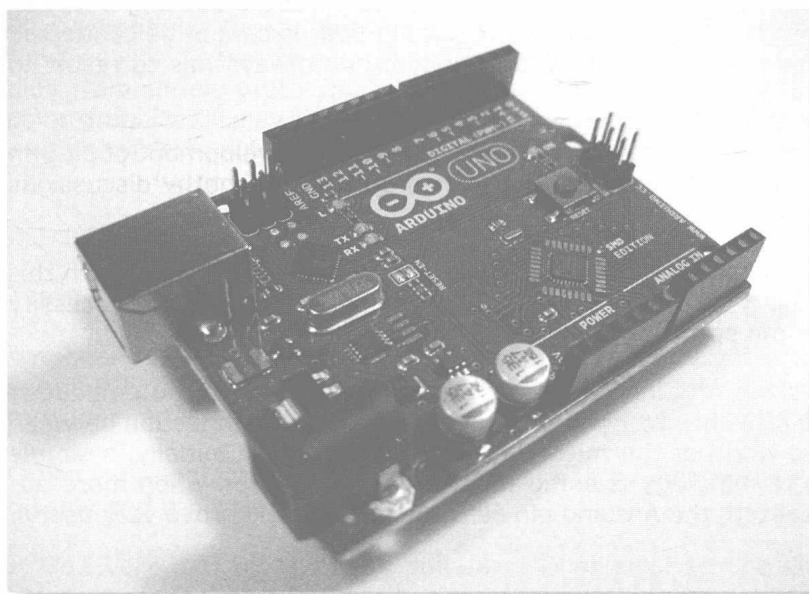


Figure 2.1:
Arduino Uno SMD

The original ATmega8 processor was also replaced by the more powerful ATmega168 and ATmega328 variants. In parallel with the main line of development, several more-or-less compatible offshoots have emerged over the years. For example, there are rugged versions in which all ports are specially protected against overvoltage and short circuits, and special versions with custom form factors and pin spacings.