Arduino Programming Projects

Learn how to build cool, fun, and easy Arduino Projects

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Dedicated to

My beloved Parents:

Shri Dhananjay Kumar Barnwal

Smt. Shobha Barnwal

&

My altruistic elder brother Rahul Barnwal

About the Author

Rohan Barnwal is a highly creative and innovative individual with a passion for electronics and a love of problem-solving. With a natural talent for finding creative solutions to complex challenges, Rohan has been creating innovative projects since 2015. He has already made a name for himself in the world of electronics. Despite his young age, Rohan is already a highly accomplished individual. Currently in high school, he is preparing for engineering entrance exams and has set his sights on a bright future in electronics. He is driven by a desire to make a difference in the world and is eager to use his knowledge and expertise to create innovative solutions that will improve people's lives everywhere. With his passion for electronics, his love of problem-solving, and his commitment to innovation, Rohan is poised to make a significant impact in the world of electronics. He is an inspiration to all who know him and a testament to the power of determination and hard work.

About the Reviewers

- **Maria-Anastasia Moustaka** holds a Diploma in Computer Engineering and Informatics. She is working as a software engineer and robotics educator. She has also been awarded as a Microsoft Internet of Things Most Valuable Professional – MVP and as a Gold Microsoft Learn Student Ambassador, and carries four awards in international robotics competitions with the Robotics Club UoP.
- **Pradeepkumar K** is an Embedded Hardware Design Professional with 7 years of experience on the Requirements Gathering, System Architecture Design and Hardware PCB board Design, Product Development and Testing and production. He has an outstanding knowledge of the design and testing of digital and analog systems that helps develop the product available on the market. He has wide experience in product design, based on EMI/EMC testing –RE, RS, CE and CS as per IEC 61000 4-2. ESD-IEC 61000 4-2, EFT as per IEC 61000 4-4, Electrical Surge Testing as per IEC 61000 4-5, as well as Product Environmental Testing to analyze failure nodes.

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Thank you all for your time, support, and encouragement. I am deeply honored to have had the opportunity to share my work with you.

Preface

I am pleased to present this book on Arduino and its projects. The book is aimed at absolute beginners who have no prior knowledge of the subject matter and are looking to explore the exciting world of electronics and programming.

This book is a comprehensive guide to electronics and programming using the Arduino platform. It begins with a comprehensive introduction to the fundamentals of electronics, including an overview of the different electrical components and instruments used in the field. The book then moves on to introduce the Arduino family and provide a detailed explanation of the Arduino **Integrated Development Environment (IDE)**.

With the fundamentals covered, the book then delves into the subject's core, covering a range of example projects using the Arduino platform. These projects are designed to be accessible to beginners while providing enough depth and challenge to engage more advanced readers. Each project is accompanied by clear and concise explanations of the code and circuits used, making it easy for readers to follow along and build their projects.

Chapter 1: Basic Electronics – In this chapter, we will dive into the world of electricity and circuit design, covering the basics of static and current electricity, atoms, voltage, current, resistance, series and parallel circuits, and how to calculate resistance using the resistance color code. The reader will also be introduced to various electric tools such as the ohmmeter, ammeter, voltmeter, multimeter, soldering iron, and oscilloscope. Finally, we will look at microcontrollers and microprocessors, which play a crucial role in modern electronic devices.

Chapter 2: Introduction to Arduino – In this chapter, we will explore the exciting world of Arduino and its numerous benefits. We will also take a closer look at the different members of the Arduino family, including the Arduino Nano, Pro Mini, Pro

Micro, Leonardo, Mega, and Esplora. Additionally, we will cover the various Arduino Shields that can be used to expand the functionality of your projects. We will also provide an overview of Arduino's relationship to the AVR architecture. To help you get started with Arduino, we will discuss the various resources and learning materials available. Finally, we will explore the differences between official Arduino boards and clone Arduino boards, as well as provide tips on choosing the right board for your needs when buying your own Arduino board.

Chapter 3: Communication with Arduino – In this chapter, we will focus on getting you comfortable with the Arduino Integrated Development Environment (IDE), the software you will use to program and interact with your Arduino board. We will introduce you to some of the basic terminology associated with the Arduino platform and guide you through installing the Arduino IDE on Windows OS. Once you have the IDE installed, we will take you on a tour of the interface, highlighting the different parts such as the menu bar, toolbar, text editor, status bar, message window, board status bar, progress bar, and cable. This chapter will provide a solid foundation for your future projects with Arduino.

Chapter 4: Programming with Arduino IDE – In this chapter, we will delve into some programming concepts with the Arduino IDE. We will start with discussing the void function and the basics of variables, including data types and how to declare and assign values to variables. You will learn about comparison and arithmetic operators and some of the basic commands commonly used in the Arduino IDE. We will also cover constants and provide a deeper look into the syntax of the C programming language used in the Arduino IDE. Additionally, we will explore loops and discuss the importance of variable scopes and qualifiers. Finally, we will discuss libraries in the Arduino IDE and the various ways to import and utilize them in your projects.

Chapter 5: PWM and Serial Data Transfer – We will dive into more advanced topics related to the Arduino platform. We will start with an overview of Pulse Width Modulation (PWM) and

its use in the Arduino environment. You will learn how to create a simple LED fade project using PWM, and we will also cover the various memory architectures in Arduino and how to manage memory in your projects. Additionally, we will discuss serial data transfer, including the Arduino serial library and the Arduino SPI (Serial Peripheral Interface) library. This chapter will help you expand your understanding of the possibilities and limitations of the Arduino platform and will provide a solid foundation for more advanced projects.

Chapter 6: First Arduino Project LED Blink Project – In this chapter, we will dive into our first project with the Arduino platform. You will learn how to turn an LED on and off with a one-second interval, providing a hands-on introduction to the basics of the Arduino platform and the process of building simple projects. This project will serve as a starting point for further exploration of the Arduino platform and the possibilities it offers for electronics and DIY projects. Get ready to dive in and start blinking those LEDs!

Chapter 7: What if You Don't Have Arduino – In this chapter, we will explore the world of circuit simulation with Tinkercad. You will learn about a simulator and why it is a valuable tool for electronics and programming projects. You will also learn how to use Tinkercad, as well as how to create an account and start working with the platform. We will cover the various options available in Tinkercad, including coding and circuit design, and you will learn how to build a simple LED blink project using the Tinkercad simulator. By the end of this chapter, you will have a solid understanding of how Tinkercad works, how it can help you build and test your projects before putting them into physical form, and how different physical form is from simulation.

Chapter 8: Fundamentals of Arduino – In this chapter, we will delve into the components and features of the Arduino UNO board. We will examine the different parts that make up the board and how they work together to enable you to control and interact with your projects. You will also learn about the unique features of other Arduino boards, such as the Leonardo and Pro Micro, and how

they differ from the UNO. Finally, we will discuss how you can provide power to your Arduino board and how to ensure that you are using the correct power source for your specific project needs. By the end of this chapter, you will have a good understanding of the Arduino UNO board and be well on your way to creating your projects with this versatile platform.

Chapter 9: Sensor Modules Motor and Display – In this chapter, we will dive into the world of sensors, modules, and various electronic components that play a vital role in Arduino. We will learn about different types of sensors and modules, their functioning, and how they can be utilized in various projects. We will also explore the different types of essential electronics components like breadboards, electric motors, motor drivers, and displays like LCD, OLED, touch screen displays, and E-Ink displays.

Chapter 10: Projects Using Arduino – In this chapter, we will cover the various Arduino projects and applications, including LED Chaser, Brightness Control, turning LED on/off using a push button, reading distances with an ultrasonic sensor, printing on LCD and OLED displays, controlling servo motors, reading heartbeat, controlling AC appliances, creating fire alarms and PIR sensors, and using touch and force sensors.

Whether you are a student, hobbyist, or simply looking to learn more about electronics and programming, this book provides a solid foundation and a wealth of knowledge to help you get started. I hope this book will inspire you to explore the exciting world of Arduino and unleash your creativity as you build your projects.

Enjoy the journey!

Sincerely,

Rohan

Code Bundle and Coloured Images

Please follow the link to download the
Code Bundle and the *Coloured Images* of the book:

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The code bundle for the book is also hosted on GitHub at **https://github.com/bpbpublications/Arduino-Programming-Projects**. In case there's an update to the code, it will be updated on the existing GitHub repository.

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