Getting Started with Electronic Projects

Build thrilling and intricate electronic projects using LM555, ZigBee, and BeagleBone

Bill Pretty
In this package, you will find:

- The author biography
- A preview chapter from the book, Chapter 1 “Introduction – Our First Project”
- A synopsis of the book’s content
- More information on Getting Started with Electronic Projects

About the Author

**Bill Pretty** began his career in electronics in the early '80s with a small telecom start-up company that would eventually become a large multinational. He left that company to pursue a career in commercial aviation in Canada’s north. From there, he joined the Ontario Center for Microelectronics, a provincially funded research and development center. After that, a career in the military as a civilian contractor at what was then called the Defense Research Establishment Ottawa. This began a career that was to span the next 25 years, and continues today.

Over the years, he has acquired extensive knowledge in the field of technical security and started his own company in 2010. That company is called William Pretty Security Inc. and provides support, in the form of research and development, to various law enforcement and private security agencies.

He has published and presented a number of white papers on the subject of technical security. He was also a guest presenter for a number of years at the Western Canada Technical Conference, a law enforcement-only conference held every year in western Canada. A selection of these papers is available for download from his website ([http://www.williamprettysecurity.com/](http://www.williamprettysecurity.com/)).

There a number of people I would like to thank, for without their support, this book would never have been completed. My good friends at Packt Publishing for having the patience and trust in me once again. To my partner in life, Donna, who never stopped believing in me. Last but not least, my good friends and fellow code warriors Willie the Mad Scott and Glen the flying Dutchman.
Getting Started with Electronic Projects

In this book, I have tried to include something for readers with various skill levels and interests. It contains hardware projects, software projects, and a combination of both. In all cases, I have tried to begin with a simple project and moved on to progressively harder and more complex projects. Depending on your skill level, some projects will take an hour or so to build and some will take longer.

Either way, I hope you will enjoy building the projects as much as I have enjoyed writing about them.

What This Book Covers

*Chapter 1, Introduction – Our First Project*, explains how to practice our soldering and de-soldering skills by building an infrared flash light and head lamp.

*Chapter 2, Infrared Beacon*, continues with our infrared light project—that is, building an invisible infrared flashing beacon.

*Chapter 3, Motion Alarm*, explains how to build a simple but effective intruder alarm with the always popular LM555 timer.

*Chapter 4, Sound Card-based Oscilloscope*, covers the beginning of the combined hardware and software projects. We will be building some hardware. It will allow you to use a USB sound card as a simple but useful oscilloscope.

*Chapter 5, Calibrated RF Source*, introduces you to the wonderful world of RF when you build a 50 MHz calibrated reference. Useful on its own, it will also be used in the next chapter.

*Chapter 6, RF Power Meter – Hardware*, shows us how to build ourselves a meter capable of measuring RF power at various frequencies. We will avoid most of the layout headaches by using a demo board provided by the manufacturer of the power detector.

*Chapter 7, RF Power Meter – Software*, explains how to build a BeagleBone Black-based software development system. Then, we will go on to write the software which will not only measure RF power but will also control an external RF attenuator.

*Chapter 8, Creating a ZigBee Network of Sensors*, covers how to build a wireless security system for your home or office based on the ZigBee RF module.
Introduction – Our First Project

In this book, we’ll build several projects that will get progressively more challenging. You should be able to build the first few projects in an afternoon. A finished product may take you a while longer, depending on how professional you want it to look.

In order to build the first few projects in this book, you will need a few basic assembly skills and tools described as follows. The RF projects will require access to and knowledge of RF spectrum analyzers and/or RF power meters.

- You should be able to solder through hole parts
- You should be able to use a solder removal tool such as a solder sucker or solder wick
- You should be able to read the color codes of resistors
- You should be able to read voltage, resistance, and current with a multimeter

That’s it folks! In order to build and use the first few projects, you don’t have to know how to write a single line of code.
Basic tools
The basic tools that you’ll need are as follows:

- Soldering iron or soldering station:

- Diagonal cutters:
• Needle-nose pliers:

• Jewelers' screwdriver set:
• Solder sucker or solder wick. Or both:

• A multimeter is capable of measuring volts, ohms, and milliamperes. The meter shown in the following image is a RadioShack/Micronta multimeter. If you have an opportunity to purchase one of these on eBay or at a Hamfest, I highly recommend you to do so. I have had this one for years. In addition to the usual meter functions, it also has a serial RS-232 output that has come in extremely handy over the years.
The more difficult projects will require access to either a BeagleBone Black or White, but we'll get to that later. Let's start our first project.

This project is the first in a series of projects for all you weekend warriors—paintball and Airsoft enthusiasts.

In this project, we will modify a standard LED flashlight that is available from eBay or your local variety store for a few dollars. What we are going to do is remove the visible light (white) LEDs and replace them with infrared LEDs. You might ask, Why would we want to do that? This is because many Airsoft and paintball rifles and pistols are equipped with a flashlight holder to allow the shooter to see his/her target in the dark. The downside to this is that your enemies can see you coming a mile away! So what we are going to do is make ourselves an infrared flashlight, which will allow us to see our target in the dark without it seeing us. Most inexpensive black-and-white video cameras can actually see well into the IR range, as can night-vision goggles. There are a number of inexpensive night-vision devices available from the sites that sell Airsoft gear, so I won't get into that here.

So, let's get started. This project basically involves desoldering and soldering. By the time we are done, you will be really good at both.
Introduction – Our First Project

The preceding image is of the flashlight that I purchased at a local hardware store for about $2.00. Yours might not be exactly the same, but the principle of what we are about to do will work for just about any LED flashlight. All I would suggest is that you purchase one with as many LEDs as possible.

Flashlight – step 1

The first thing we have to do is to remove the plastic lens from the flashlight. We do this for two reasons: First of all, you will probably have to remove it in order to get to the LEDs. The second is that plastic tends to diffuse and attenuate infrared energy. I pierced the lens with a sharp object and popped it out, as you can see in the following image:

Lens removed
As you can see, the LED assembly is now loose in the case. If we remove the assembly and turn it over, we can see how the LEDs are connected to the battery pack. The positive or anode end of the LED is connected to the center terminal of the pack while the negative or cathode end of the LED is connected to the case.

Rear view of PCB

**Flashlight – step 2**

OK, time to warm up the old soldering iron and have at it. What you have to do is basically remove all the LEDs from the PCB without damaging it. Fortunately, these flashlights are cheap, so you can buy a couple of flashlights depending on your confidence level.

Once you have all the diodes LED’s removed, it is time to replace them with the infrared ones. If you’re lucky, the LEDs you are installing will have a flat side on the case. This is the cathode or negative side of the LED and it should be soldered to the negative side of the PCB.
Some LEDs have one short lead and one long one. The short one is supposed to be the cathode, but I would highly advise checking to be sure. The following image shows how to check your LED using the diode setting on your multimeter. In my case, it is indicated by an image of a diode.

![Finding the cathode with a meter](image)

Checking an LED is like checking any other diode. With the negative lead of the meter connected to the cathode (short lead) and the positive lead connected to the anode (long lead), you should get the minimum reading of ohms.
Because LEDs do not behave like normal diodes, this test might not work. If you don't have a diode setting on your meter, just use the lowest ohm range. If you aren't sure, then the easiest thing to do is solder one LED and then temporarily reassemble the flashlight. If you cup your hands around the lens, you should see a faint red glow from the LED.

Now that you have the first one installed correctly, all you have to do is repeat the process for as many LEDs as you have. Once you have all of the LEDs installed, you should check the project by pointing the flashlight at a cheap black-and-white video camera. You should see the glow from the LEDs. One way to check if the camera will work is to point your TV remote at the camera and see if you can see the LED flash when you press a button on the remote.
Introduction – Our First Project

Once you have tested your Special Ops flashlight, you should use 5 minute epoxy glue to hold the LED assembly in place.

Your finished flashlight will look much like the following image:

![Finished flashlight](image)

If you enjoyed this quick and hopefully easy project, there is another one similar to it in the following pages. Many of you have probably seen LED headlamps in camping and hardware stores. The following pages will show you how to modify one of these lamps in pretty much the same way as we did the flashlight.

If you're a nature lover rather than a weekend warrior, you might find this project useful because it will free your hands for your camera or binoculars.
Headlamp – step 1

The following image shows the headlamp that I used. Yours will probably look very much the same.

We will be disassembling the headlamp in the same way as the flashlight. Simply turn the bezel until it comes out in your hands. Once again, we are talking about a $2.00 investment here so you might want to buy a couple, just in case you have to sacrifice a few in the name of science.
Once you remove the two small Philips screws, you can now remove the circuit board containing the LEDs. The headlamp I purchased came with a switch that allows you to have one, three, or all the LEDs on at the same time. I’m not sure how practical this is for our project, except possibly to conserve battery power.

Now that you have the lamp apart, it is time to fire up the soldering iron and solder removal tool and go to it. As in the previous project, simply replace the white LEDs with IR ones and off you go.

The cool thing about this lamp is the LED selector switch that allows you to turn on one, three, or all LEDs. If you are going to use it for nature observation, you could build yourself a lamp with three red LEDs and four white ones. That way, you can move about with the red LEDs and not ruin your night vision, unless you see something interesting.
Summary
This chapter contained two hopefully simple projects that allowed you to blow the dust off or enhance your soldering and desoldering skills. These skills will come in handy in the chapters to follow. We built two inexpensive but useful projects. All for about $5.00 per project, depending on how much the LEDs cost you.

Use your imagination. How about blue LEDs and wearing the lamp on your chest or head for Halloween?

In the next few chapters, your soldering and construction skills will be challenged even further, as we build a motion sensor out of a piece of a water pipe and a flashing infrared beacon. So read on.
Where to buy this book
You can buy Getting Started with Electronic Projects from the Packt Publishing website. Alternatively, you can buy the book from Amazon, BN.com, Computer Manuals and most internet book retailers. Click here for ordering and shipping details.