1/Introducing Trinket

The Arduino has revolutionized the use of microcontrollers—programmable electronics—in the last several years, providing easy-to-use hardware and software at a reasonable price point. The often-cited Internet of Things has grown from this ubiquity of easy-to-use programmable electronics, sensors, and communications.

One of the few disappointments that typically comes after building a permanent project is, "I used my Uno in my project, and now I no longer have my $30 board." That, and the fact that many projects do not require all the horsepower and connectivity an Arduino Uno or larger board offers.

This "bigger is not always best" situation offered an opportunity to Adafruit Industries, a small company based in New York City. Specializing in innovative open source hardware, Adafruit has grown to become a premier supplier to hobbyists and industry. *Entrepreneur* magazine named Adafruit founder Limor "Ladyada" Fried as Entrepreneur of the Year for 2012, and she has been featured in *WIRED Magazine*, *Popular Mechanics*, and other publications.

Ladyada has an uncanny ability to look at the needs of customers and personally oversee the design of product solutions. The need for an inexpensive microcontroller that can be built into projects (without guilt) led to her introduction of the Trinket.

Trinket Versus Arduino Uno

As many people are familiar, at least in part, with the Arduino Uno, a comparison may help (see Figure 1-1).

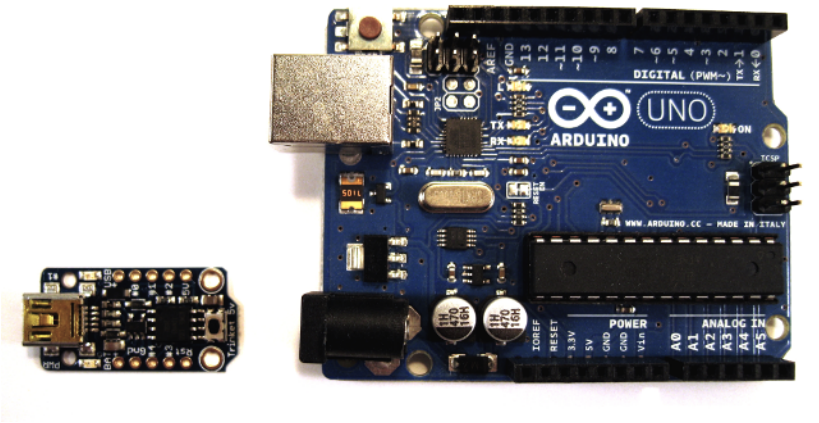

Figure 1-1. *The Adafruit Trinket (left) and the Arduino Uno (right)*

Table 1-1 compares the features of each.

Table 1-1. *Trinket and Uno feature comparison*

	Adafruit Trinket	**Arduino Uno**
Pins (digital/analog)	5/3 (shared)	13/6
Pulse width modulated pins	3	5
Pin voltage	3.3 or 5 volts	5 volts
Memory (flash/RAM/ EEPROM)	8KB/512 bytes/512 bytes	32KB/2,048 bytes/ 1,024 bytes
Size (mm)	1.2 × 0.6 × 0.2 inch/31 × 15.5 × 5	2.96 × 2.1 × 0.59 inches/75.14 × 53.51 × 15.08
Approximate cost	$6.95	$29.95

Using Trinket

Many projects do not require the size, power, and capabilities of larger Arduino compatibles. Here are some categories of projects where the Trinket may be a good choice:

Wearables
: Wearables are a rapidly growing use for electronics. With its small size and low power requirements, the Trinket is being used in a growing number of clothing and body wear projects.

Sensing
: The Internet of Things is composed of many small smart sensors communicating information about the world around us. The Trinket is perfect for attaching a wide variety of sensors and displaying or communicating sensor status.

Tiny projects
: The Trinket is well suited for any use where programmability is desired in a small package. Very small robotics projects can be made with a Trinket.

Lights and display
: Coupled with light-emitting diodes (LEDs), the Trinket is a great choice for DIY lighting projects. Used with smart red-green-blue (RGB) LEDs, a Trinket can perform complex light animations. Adafruit's smart RGB LEDs, *NeoPixels*, are controlled with only one data pin. You can drive LED and character displays with only two pins.

New uses for the Trinket appear regularly on Internet project sites including Instructables, Google+, and the Adafruit blog, and forums.

The ATtiny85 Microcontroller

At the heart of the Trinket is the ATtiny85 microcontroller (Figure 1-2), produced by Atmel Corporation. Despite having only eight pins in a tiny package, this controller provides the functionality of traditionally larger processors.

The ATtiny85 was introduced by Atmel as an extremely small controller on the outside with many of the features of larger processors inside.

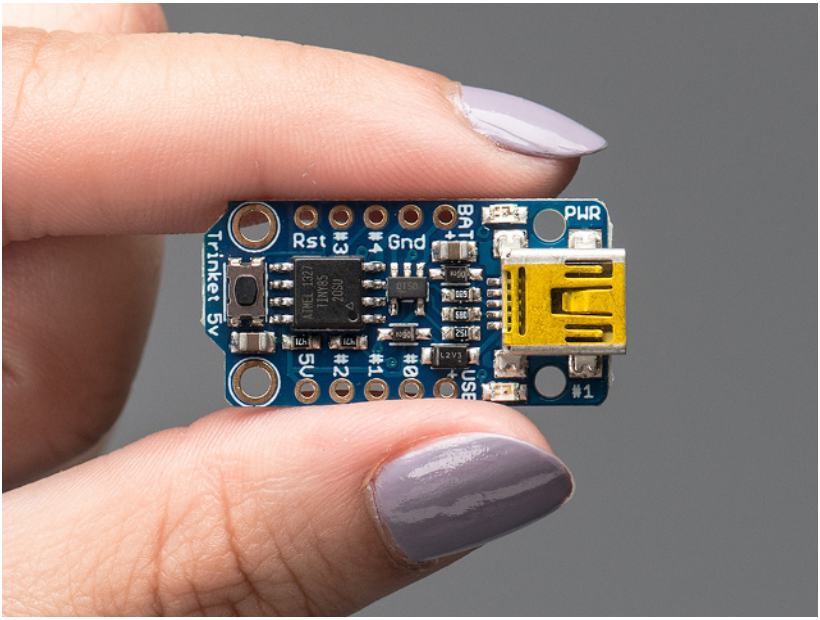

Figure 1-2. *The ATtiny85 (the small black square on the Trinket)*

Memory

As you can see in Figure 1-3, this chip has three different types of memory. The ATtiny85 has 8,192 bytes of flash memory for programs. The Trinket contains *bootloader* code, which occupies part of this. The bootloader assists in loading user programs from the universal serial bus (USB) port. Adafruit has developed a custom bootloader based on the V-USB project. With the bootloader in flash memory, there is approximately 5,130 bytes of program memory available for user programs. Random access memory (RAM) is used for program variables. The ATtiny85 has 512 bytes of RAM, which seems like a minuscule amount compared to the 4 GB on a typical laptop, but in practice this is often more than enough for many programs.

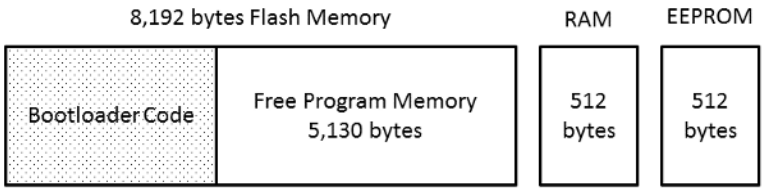

Figure 1-3. *The Trinket memory map*

Finally, the chip also contains 512 bytes of *electrically erasable programmable read-only memory* (EEPROM). You can use this memory to store user data that remains even after the Trinket is powered off. This is useful to save data such as setup information, state data, or critical readings. This memory can also be useful for storing static information such as character strings a program might use, which otherwise would occupy precious program flash memory or RAM. However, programmers must weigh the benefits of using EEPROM against the additional code the compiler may add to manipulate data. Most programs do not use EEPROM.

Connectivity

The ATtiny85 chip uses only six pins for input and output, with two pins for power and ground. Atmel engineers cleverly assigned multiple types of functionality to each pin, as shown in Figure 1-4.

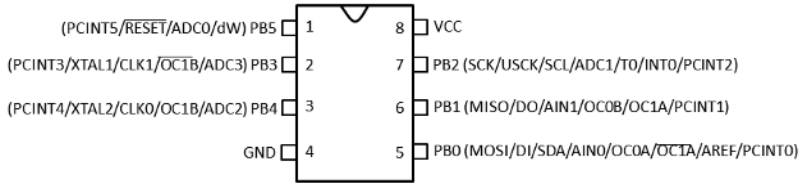

Figure 1-4. *The multiple functions on the ATtiny85 pins*

In the design of the Trinket, Adafruit exposes much of the chip functionality. The designers added the ability to communicate over the USB serial port, as well as status lights and a reset button. Figure 1-5 shows the Trinket 5V and the functionality onboard. The pins' functions are listed in Table 1-2.

Data is exchanged via the pins marked #0, #1, #2, #3, and #4. The sixth data pin (PB5) is permanently connected to the reset button and RST input; it cannot be used as an input/output pin due to how the Trinket is configured.

The Trinket has a power input pin, usually for a battery. There are also two voltage output pins: one for USB power (if connected to a computer) and a regulated power output tied to the battery input with a maximum power draw of 150 milliamps (mA).