Many companies sell alternative authentication devices and software packages for personal and corporate computers, but most dig too deep into the pocketbook. Biometric fingerprint scanners sometimes take several attempts to work, and the sensor is prone to scratches or other types of damage. Smart cards work fine, but are complicated to implement, and the electronic contacts in the readers and on the cards wear out—remember the old cartridge based game consoles like the Atari 2600 or the original 8-bit Nintendo console? For those of you too young to remember those days, the contacts on the game cartridges and consoles would wear out. You'd either spend all your leisure time frantically jamming cartridges in and out of the machine, trying to get them to work, or maybe you'd get a few minutes of game play in before being shut down by an entire screen of gibberish and fuzz because the cartridge contacts failed.

With RFID being impervious to dust and dirt, and being contactless, it's a perfect candidate for desktop authentication. In this chapter, you’re going to build a covert RFID-enabled USB keyboard (shown in Figure 4-1) that keeps its enhanced functionality a secret from the general public. You'll be using open source software to enable the login process on your Windows-based computer.

This project involves making changes to your Windows PC operating system and registry settings, which could render your PC inoperable. Proceed at your own risk. You should know how to make changes to the Windows registry and be comfortable with the possible risks before attempting this project.

Figure 4-1: RFID-enabled Microsoft Natural Elite USB Keyboard

Parts and Tools
You need the following parts for this project:
1. Phidgets USB 125KHz RFID reader from www.phidgetsusa.com
2. Passive EM4102 type 125 KHz RFID tag
3. Microsoft Natural Elite USB/PS2 keyboard
4. Targus 4-port travel USB hub, model PA055
5. Phidgets software downloaded from www.rfidtoys.net or www.phidgetsusa.com
6. RFIDGina software package downloaded from www.rfidtoys.net

And here are the tools you need:

1. Soldering iron and solder
2. Desoldering wick or solder vacuum tool
3. Philips screwdrivers (large and small)
4. Exacto knife, Dremel tool, or side cutters
5. Hot glue gun and glue

**Build the Hardware**

If you don't like the idea of using the Microsoft Natural Elite keyboard and want to build this project using another make and model, make sure the keyboard is USB. Also try to find one that seems to have plenty of empty space inside the casing. The Microsoft Natural Elite has a built-in wrist rest that is part of the casing and not a cheesy add-on like some keyboards. That extra space is a perfect place to put the RFID reader and accompanying circuitry.

**Step 1: Prepare the Keyboard**

Flip the keyboard over so the keys are on the desk and you're staring at the screws in the back. Take them all out, being careful not to press down too hard while removing them. You need to keep the keyboard together after the screws are out, and pressing down pushes the keys into the desktop, separating the keyboard housing. Once the screws have all been removed, carefully flip the keyboard back over so it's resting on its little rubber feet again.

Carefully lift the top cover off the keyboard, leaving the keys resting on the bottom half of the keyboard casing as shown in Figure 4-2. As you lift the top cover off, there is a keyboard controller circuit board situated just under the space bar that will lift up with the top cover. Notice how the keyboard membrane that stays with the bottom half is pressed up against the keyboard controller, making contact through carbon leads. Be sure to keep in mind how these parts fit together because you'll need to put this back together eventually. Also be aware that the keyboard's USB cable will come up with the top cover as you lift. Once you've separated the top cover carefully set the bottom half aside. Disconnect the keyboard cable from the keyboard controller and remove the cable, setting it aside as well.
Now you should have the plastic top cover sitting in front of you, face down, so you're looking at the inside of it. The RFID reader and USB hub will be situated in the wrist rest portion of the keyboard, so you'll need to make room for these additional components by cutting off and trimming down some plastic support stanchions. Start by removing the two cable-guide support posts to the left of the keyboard controller as shown in Figure 4-3. Cut these off using your favorite cutting tool, making sure nothing but smooth plastic remains.

The other plastic piece you need to trim is an actual screw mount and support, just to the right of the keyboard controller. Figure 4-4 shows the mount post you need to trim. You might want to remove the keyboard controller and set it aside before cutting this post off. You need to remove completely and smooth down both the screw mount post itself and the bridging support as shown in Figure 4-5. Be sure not to cut or damage the other nearby support stanchion.
Figure 4-4: Cut-off screw mount post and support stanchion

Figure 4-5: Completely flat screw mount post and support stanchion

**Step 2: Prepare the RFID Reader**

Desoldering components is really quite easy if you have the correct tools. You need a soldering iron and a solder wick, which looks just like a thick candlewick, only made of copper. The basic idea is, you heat up the solder points on the board holding the component in place and the wick will soak up the solder, leaving the solder point on the board devoid of solder. The component should lift right out. To do it, you just place the wick over the solder point you wish to desolder, and then press it down into the solder point with the soldering iron. The heat transfers through the wick and heats the solder until it flows to the wick. Because solder only flows to unused portions of the wick, keep trimming off the solder-soaked end of the wick as you move from point to point.

If you have a solder vacuum, it's basically the same idea, except you just heat up the solder with the iron until it's liquid, then without moving the iron, place the vacuum tip as close to the solder point as possible and press the button. The solder is sucked right into the vacuum. Figure 4-6 shows a standard Phidgets RFID reader board just out of the box. Let the **hacking** begin.
Desolder and Remove Components from the Board
The Phidgets RFID reader board is a little too bulky and square to fit into the keyboard wrist rest comfortably, so you have to remove some components and trim the board down. Start by removing some bulky components from the board.

Flip the reader over so you're looking at the flat side with no components on it. The Phidgets RFID reader has a large square USB type B port on it, and that's the first component you'll remove. Start by using your solder wick or solder vacuum to remove the solder from the two large mount points holding the connector in place. Once those are loose, you can desolder the four actual USB data and power pins and lift the connector off the board. The other component you'll remove is the output connector block. Desolder this connector and lift it off the board. Thanks to surface mount technology, this should leave you with a relatively flat circuit board.

Trim the Board Down to Size
To make the board fit properly, you have to trim some of the excess circuit board material from the corners, rounding the edges. With the board sitting component-side up, with the antenna section facing up and away from you, use an Exacto knife or Dremel tool to trim off the upper left-hand and upper right corners of the board. Make them as rounded as possible, following the curve of the antenna pathways. Trim off as much material as you can, but be very careful not to cut or scratch the pathways on the circuit board or you will severely reduce or completely destroy the effective read range. Once that's done, you can move on to trim off the lower right corner of the board. Watch out for components and pathways. Check both sides of the board before cutting. With the three corners trimmed, you can move on to the lower left corner. This corner takes some special attention.
You're going to want to completely notch out this corner of the board, following the output pathways as closely as possible without damaging them. When you're finished, you should have something that looks like Figure 4-7. **Step 3: Prepare the USB Hub**
The USB hub will be crammed inside the keyboard with the RFID reader so the finished product only requires a single USB cable connected to your PC. Otherwise two cables would be needed, one for the RFID reader and one for the keyboard itself. To get the hub to fit inside the tight confines of the keyboard casing, you remove the USB hub circuit board from its casing, and then remove any bulbous and cumbersome components from the board.

**Desolder and Remove Components from the Board**
Flip the USB hub over and remove the small Philips head screws from the back. There’s a screw under the label as well, so be sure to remove that one before trying to pry apart the case and end up with shattered plastic all over your carpet. Separate the casing and remove the circuit board. Remove the clear plastic covers over each of the USB type A ports as well. The type A ports are the short flat rectangle shaped ports that line the bottom, as shown in Figure 4-8.

![FIGURE 4-7: Phidgets USB RFID reader with trimmed edges and components removed](image)
As you did with the Phidgets reader, you have to make this board as flat as possible by removing components. Start with the large square USB type B connector. Desolder the mount points first, and then the data and power pins. Move on to the four USB type A ports, again desoldering the mount points first, and then the data and power pins. Once you have removed all the SB ports from the board, remove the external power connector from the board.

**Trim the Board Down to Size**
Now that the board is basically flat, to make it fit nicely you have to trim off the top corners as shown in Figure 4-9. With the board sitting the same way it was for soldering the jumper wire across the power connector solder points, the side of the board that had the USB type A ports should be facing you. Use your cutting tool to trim the top left corner off the board. Cut straight through the mounting hole, like you're cutting a doughnut in half. It might appear that you are cutting a pathway while doing this, but it's only a ground path, and you can cut through it safely. Now trim the top right corner the same way.

**Jumper Power Connections**
Once you've removed the power connector, you have to jumper two solder points that the connector was bridging internally, otherwise the USB hub won't power up when connected to your PC. With the board sitting component-side up and the corner where the power connector used to be now situated in the upper left corner, the three holes left by the power connector form a triangle of sorts. Solder a jumper wire from the top hole to the one sticking out to the left.
FIGURE 4-9: Trimmed and prepped USB hub board

Next week we find out how to connect components, test connections, add ports, mount components inside the casing and reassemble the keyboard and test.