How to Create Custom Sound Effects for NXT Robots.

NOTE: Note to parents and teachers: This process requires downloading software from the Internet and may require adult supervision.

An animal is just not complete without animal sounds. Granted, not all of the animals in the NXT Zoo book are known for their sounds. Still, for those animals that are, the addition of sound just makes for a better robot.

Take the elephant robot, for example. Have you ever heard of a quiet elephant? A silent elephant is not only unexciting, it's unrealistic. But a trumpeting elephant; now that is a real challenge for NXT builders.

As we work our way through the process of creating custom sound effects for the NXT, it may be necessary for you to download some free software. (*Freeware is software that can be legally down loaded from the Web and used.*) I'll give directions for this as we progress.

A Source for Sound Effects

Now I could create my own custom sounds, but it's a whole lot easier to spend about 99 cents on an elephant trumpeting sound from iTunes. If you do not have iTunes on your computer, you can download it for free from the Apple website at *http://www.apple.com/itunes/.* Once you have iTunes installed, open it and search for "elephant sounds" (or whatever animal you are creating sounds for). Once you've found the sound you want and are ready to download the audio file, the purchase can be completed with a credit card or Pay Pal.

Converting Your iTunes File

The sounds found on your NXT brick are .rso files. In fact, .rso is the only audio format the NXT can read. (*File extensions like, .jpg, .doc, .wav and .rso tell a computer what program it should call on to open or use that file.*)

What follows is a description of how you can convert an iTunes sound file to the .rso format so we can add our customized sound to the elephant.

The first step is to create a playlist of the audio files we want to convert, then use iTunes to burn the audio files to a CD. Here's the procedure:

1. Open iTunes.

2. Select **File • New Playlist**. A small box called Untitled Playlist should show up on the left side of your computer screen.

3. Drag the audio files you want to put on a CD in the new Untitled Playlist you've just created.

4. Open the Untitled Playlist and make sure the file you want is in there.

5. Put a blank CD in your computer then select **File • Burn Playlist to Disc** to copy your selected files to the CD.

Creating RSO Sound Files on a Windows PC

In order to convert our audio files to NXT-compatible files, we will need to remove your sound file from the CD, make it as small as possible and, finally, convert that file to the format the NXT requires. First let's get the sound file off the CD.

Rip the CD

A CD ripper is a Windows application that copies audio files from a CD and converts them into a form that can be changed. For our purposes, the free audio ripper Free CD Ripper will do just fine. You can download it from *www.download.com*.

After you have installed the Free CD Ripper application on your computer, insert the CD you just burned into your disk drive and launch Free CD Ripper.

If you burned your files to a CD using iTunes (and the CD is still in your disk drive), the tracks of audio files on the CD should automatically be displayed when you open Free CD Ripper (Figure X.1).
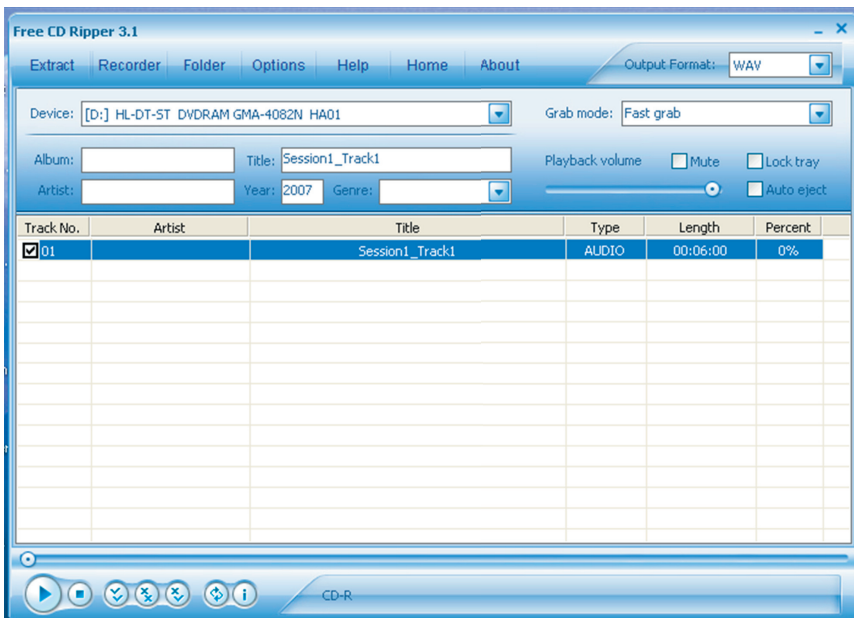

Figure X.1 Free CD Ripper 3.1shows my audio file on the CD.

Select Options (at the top of your screen). If Mono is not listed in the Channels box, click on the down arrow and choose Mono. The settings should look like Figure x.2.
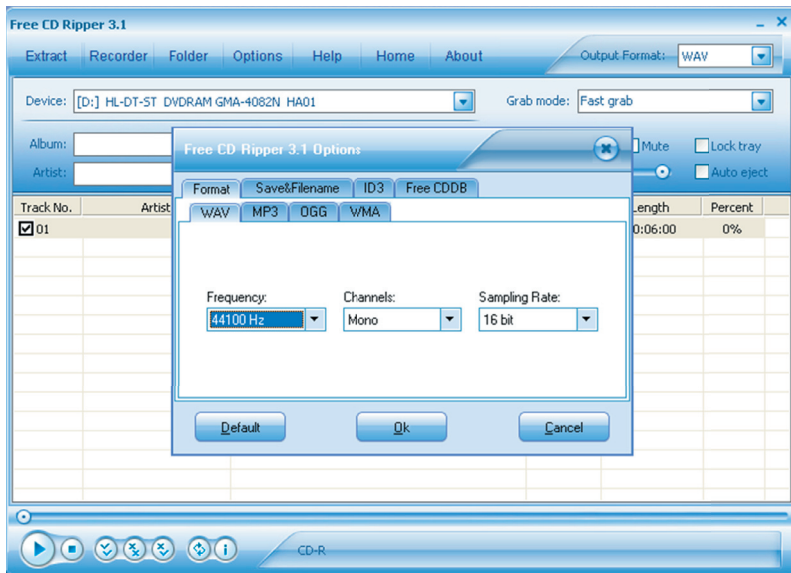
Figure X.2 Make sure Mono is selected in the Channels box.

If the settings are correct, press Ok.

Select Options again. This time, choose the Save&Filename tab. This screen allows you to choose the output folder for your ripped file. (*The output folder is where a program will save the finished document.*) After you have chosen an output folder, click Ok.
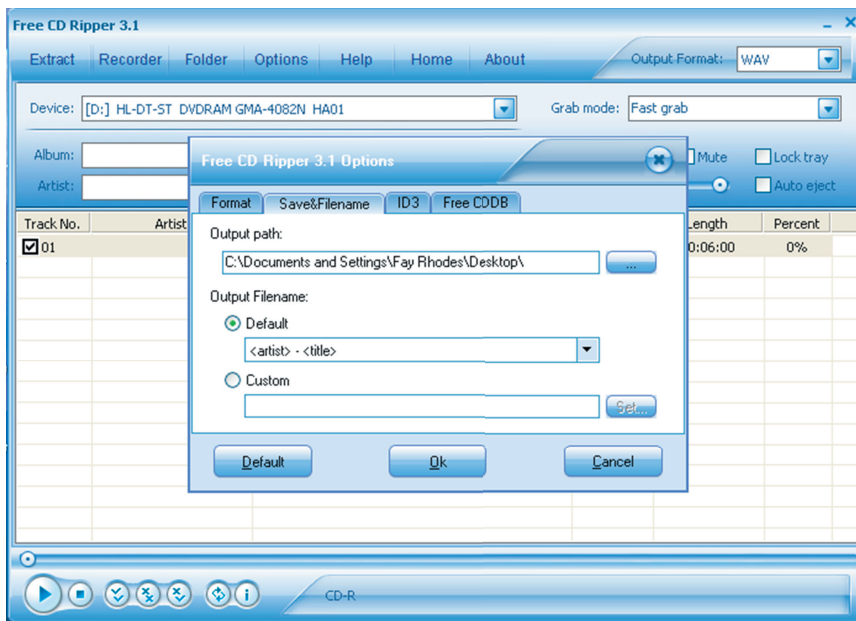

Figure X.3. I have designated the Desktop as my output folder.

Check to make sure WAV is selected as the Output Format (upper right corner of the screen) before you press Extract. When you press Extract, the conversion should proceed quickly and easily.

Small, Smaller, Smallest!

Before we go any farther, let's check on the size of the WAV file we have just created. To do this, find the file you just extracted from the CD and right-click on it. When you right-click, you should see an option called Properties. Select Properties. (Figure X.4)
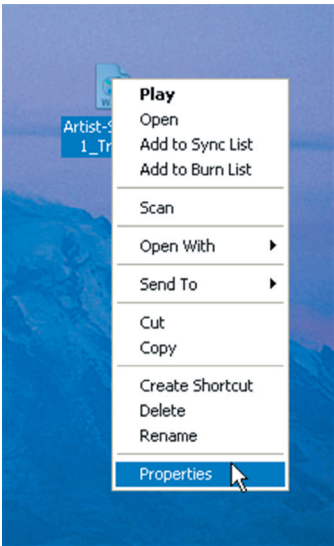

Figure X.4 Right click on the file you just extracted and select Properties.

From the information displayed on the Properties screen (Figure X.5), we can see that our WAV file is currently 1.00 MB (megabyte), which is equal to 1000 KB (kilobytes). Because the available memory on the NXT is only about 130KB, we need to make our final RSO file much smaller.
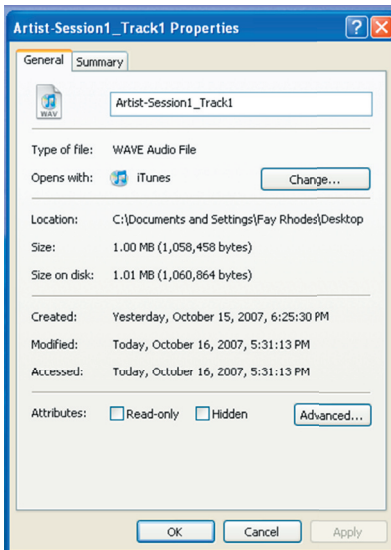

Figure X.5 In the Properties screen tells us how large the file is.

Audacity

To reduce the size of our audio files, we'll use a popular free audio editing application called Audacity. Download the Windows version of Audacity now from http://audacity.sourceforge.net/ and install it on your computer.

Once you have installed Audacity, open the program. The screen will be blank with a toolbar at the top. (See Figure x.6 below.)
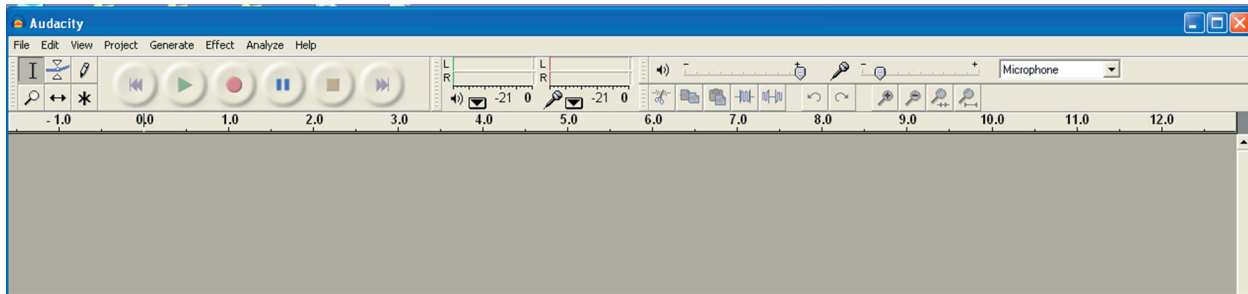

sound_7

Figure X-6 Audacity's opening screen is a blank screen with this tool bar at the top..

First, choose **File • Open** and select the audio file you just created.

When you open this WAV file, you should see a single timeline like the one shown in Figure X.9 below. (A timeline shows the progression of sound in an audio file from left to right. The wide areas are loud. The narrows sections are quiet.)

This Audacity screen turns your sound file into a picture. It moves from left to right and shows when the elephant is trumpeting loudly and when he is quiet. (see Figure x-x below)
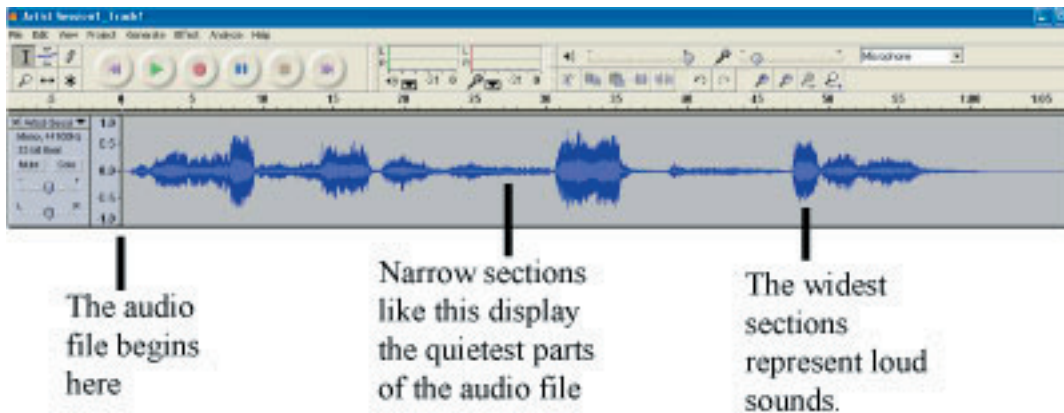

The audio file begins here

Narrow sections like this display the quietest parts of the audio file

The widest sections represent loud sounds.

Figure X-7 This screen is a way for you to look at a sound file.

If you see two timelines, as in Figure X.10, back up and rip the file again. Be sure to select MONO. (See figure X-3.)

The next step is easy. Using the buttons on the toolbar, play the sound timeline (using the arrows on the toolbar) and note where the cursor is when your favorite part is played. If you watch the timeline as it plays, you can see exactly where the sound you want to capture begins and ends.

When you've identified the part of the audio file you want to use on your robot, use your mouse to select that portion of the timeline (as demonstrated in Figures X.11 and X.12 below).
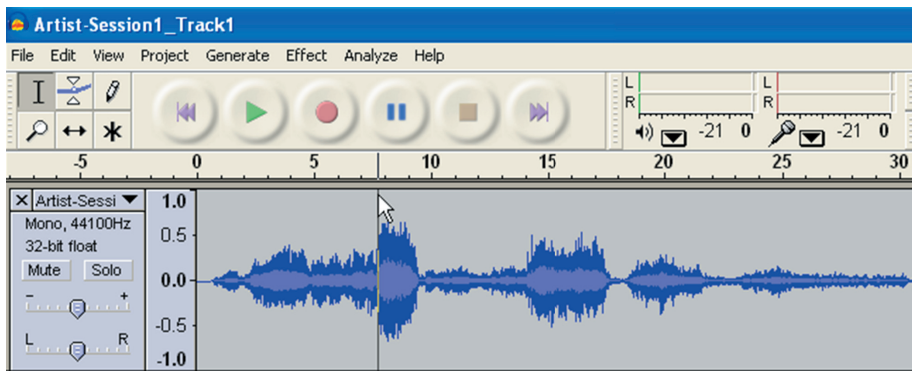
Figure X-8 To select a small portion of your sound file, click and hold down your mouse at the beginning of the portion you want.
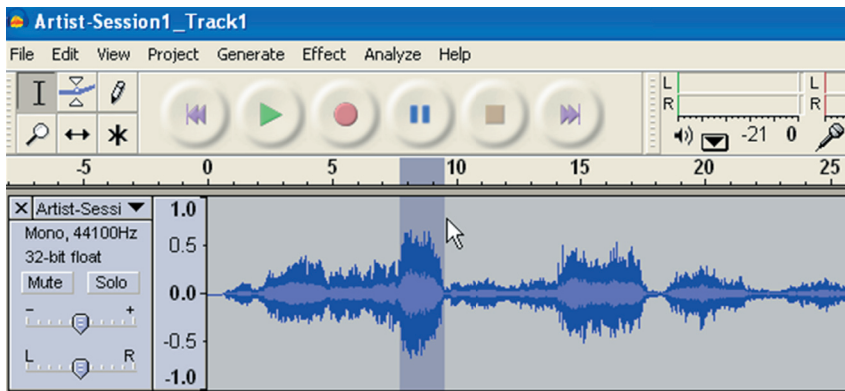

Figure X.9 Still holding your mouse down, drag the mouse to the right to select a small portion of the timeline.

Once you've made your selection, choose **Edit * Copy**, then **File • New** to open a new window. Then choose **Edit * Paste** to paste your WAV file selection into the new timeline.

Finally, choose **File * Export Selection as WAV** to place the finished WAV file in your output directory. Now check the Properties screen again
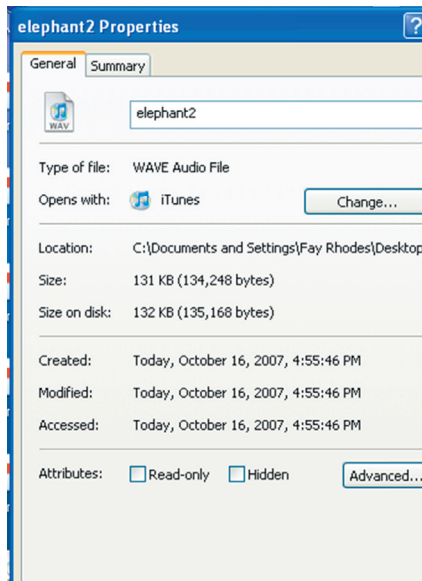
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Figure x.10 This Property screen shows that we have reduced the file size to 132 KB.

As you can see in Figure 20, our file is now much smaller (132KB), but still not small enough. The good news is that when we convert it to an RSO file, it will shrink even more. (That said, you may still find that you need to go back into Audacity and select a smaller portion of the audio file in order to reduce the file size sufficiently.)

Converting to RSO

Finally, we'll use WAV2Rso to convert our new small WAV file to the format that the NXT requires—.rso. This requires that you download and install the Wav2Rso program from *http://bricxcc.sourceforge.net/utilities.html.* To install the program on your computer, double click on the installer and follow the on-screen instructions.

After installation is complete, open Wav2Rso. The screen should look like Figure x.21.
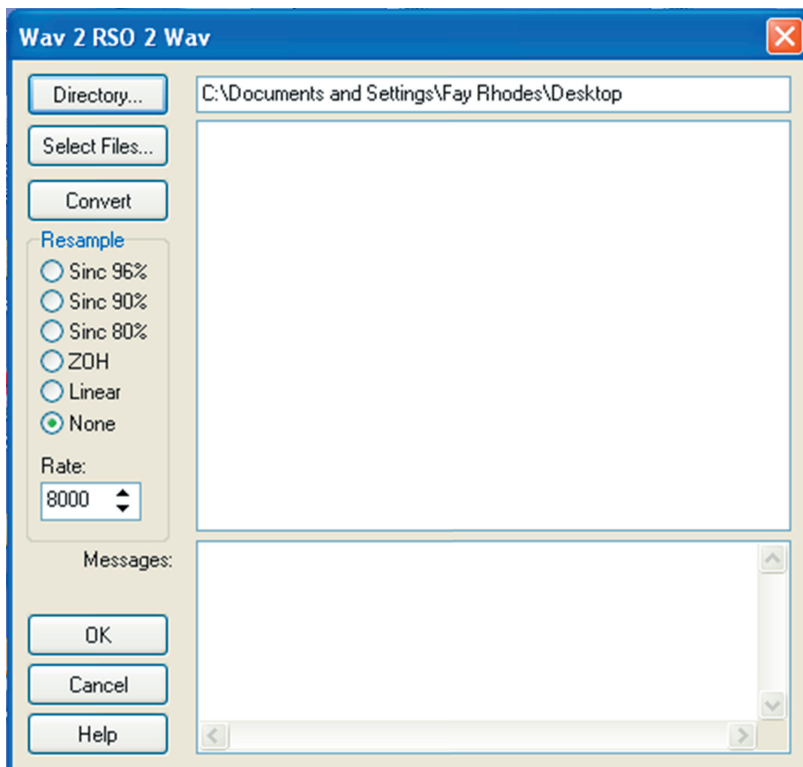
Figure x.11—The Wav2Rso opening screen

Now its time to choose the folder in which to save your converted file. You can do this by clicking on Directory (top left of the window) then browsing to that folder, as shown in Figure x.22. I've chosen to save my converted file to the Desktop.
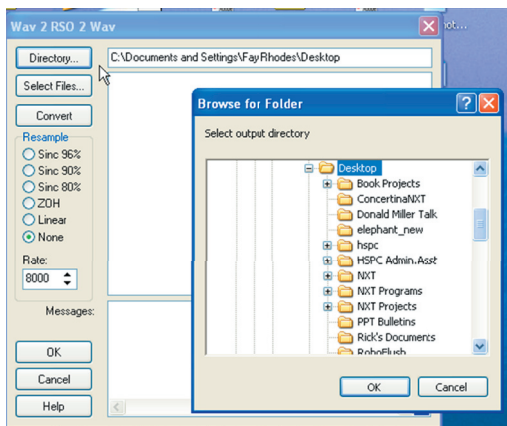

Figure x.12 Click on Directory and select your output folder.

Once you've selected the output folder, choose Select Files (top left of the screen) and open the WAV file that you want to convert to RSO (elephant2.wave in this case), then click on **Convert.**

If everything goes as planned, Wav2Rso should report a successful conversion in the Messages frame, as shown in figure Figure XX.
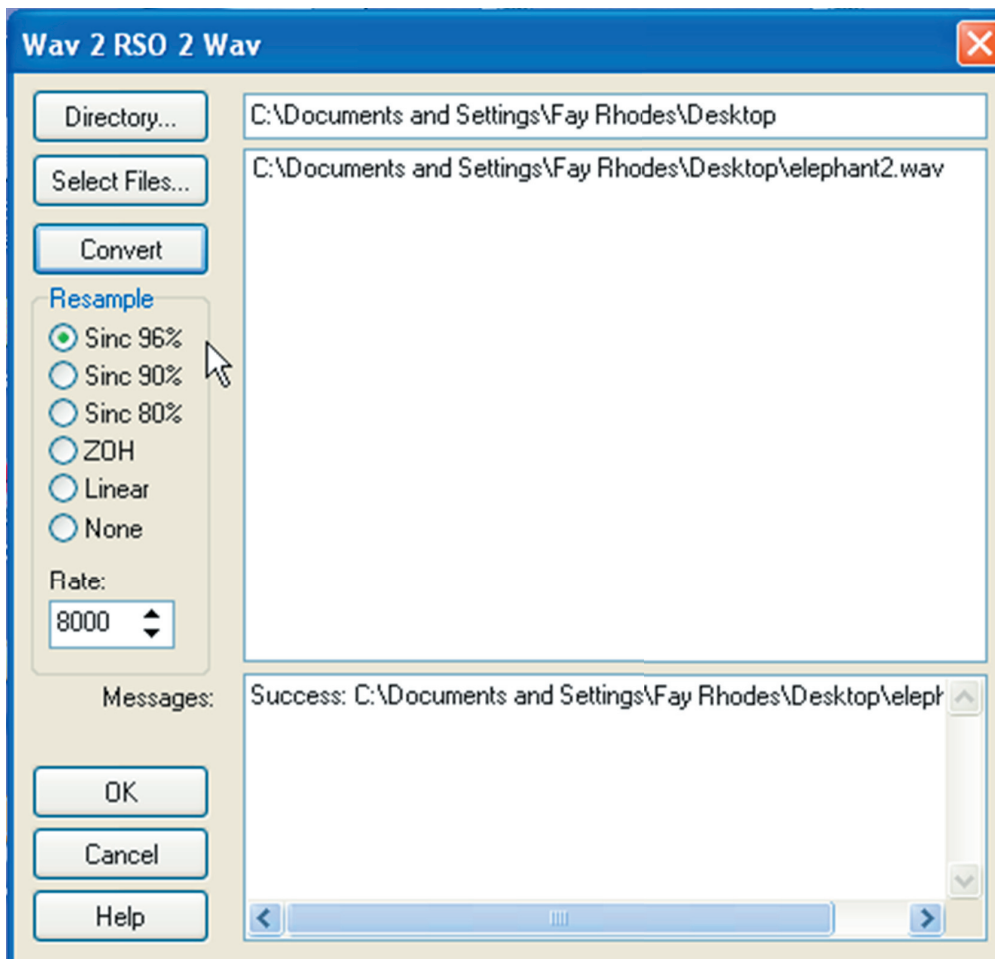
Figure x.13 The screen shows that we have successfully converted our WAV file to RSO.

If you see an error message in the Messages frame like "wave file exceeds 64k maximum size," select the Sinc 96% radio button in the Resample menu (on the left side of the window). This shrinks the file size a bit, then try the conversion again. If that doesn't work, try Sinc 80%. If the Message box still says that the file size is too large, return to Audacity and select a smaller audio clip.

Once you've got a successful conversion, right click on the resulting RSO file and choose Properties. As you can see in Figure X-14 our file is now only 11.8 KB. Much better!
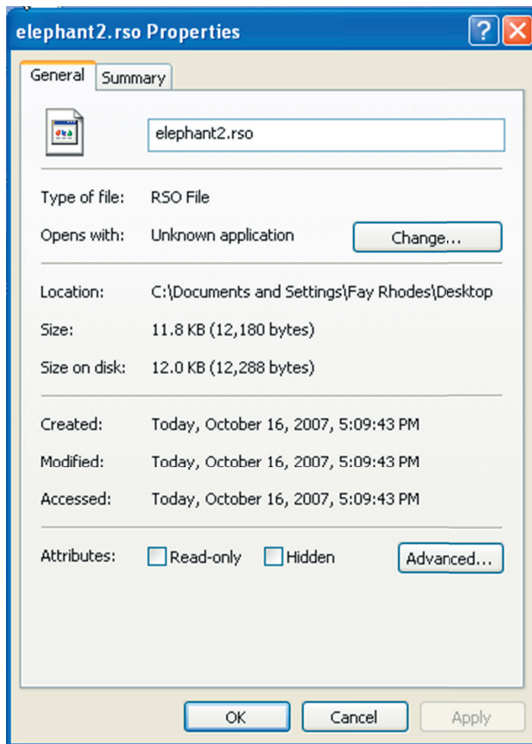
Figure X.14 Our file has been reduced from 1000 KB to 11.8 KB.

Finally, copy your RSO file to this location on your computer:
C:Programs/Lego Software/Lego Mindstorms NXT/engine/sound

Once installed there, the file will appear on the list of sounds available when you are configuring a sound sensor.

Maximizing Sound on the NXT

To allow room for custom sounds in your NXT program, you should maximize the space on the NXT Brick. Here are a few tips.

Make sure you are using the latest version of the NXT firmware available from *http://mindstorms.lego.com.*

Remove any files from the brick that you are not using including programs, sound and graphic files, and demo programs.

Use My Blocks in your programming as much as possible.

The LEGO MINDSTORMS NXT Users Guide (available from No Starch Press, nostarch.com) and the Help functions that come with the NXT software have information about managing memory and deleting folders. Be sure to read them before you begin deleting files.

NOTE: If the sound doesn't sound loud enough for you, your NXT is probably not broken. The volume levels are intentionally set low on the NXT as a safety measure.