LESSON C-6

ACTIVITY #1:
ADDING THE AMPLIFIER AND SPEAKER

In the following activities you will build a circuit that will allow for recording and playback of audio files, by adding an amplifier, speaker, USB audio device, and microphone to your circuit from Lesson C-4. You will also modify the infrared remote control program from Lesson C-2 to include a button that will play your recorded sound when pressed.

In this activity, you will modify the circuit on the breadboard to include the amplifier and speaker, and create a small program to test the audio output circuit and speaker.

This project will use the circuit from Lesson C-4, Activity #3 as a starting point:

- If you still have this circuit built, then proceed with Step #1
- If you need to rebuild the circuit, build it using the instructions from Lesson C-4, Activity #1, but do not proceed past Step #2. Our first step below will remove the entire transistor section of that circuit, so there is no reason to build that part of the circuit.

Step #1

The first step will be to make room on the breadboard for the amplifier by removing the transistors, the dual-color LED, and most of the associated components. The only jumper wires from the transistor circuit that will remain are the 5V and ground wires that are providing 5V and Ground to the P2 and N2 power rails.

Power off the Raspberry Pi before making any circuit modifications. Remove all components below Row 40 of the breadboard. This includes the dual-color LED, both transistors, both 220-ohm resistors, both 10K-ohm resistors, and any jumper wires located below Row 40. This includes both jumper wires that were connecting GPIO20 and GPIO21 to the 10K-ohm resistors. When completed, the breadboard should look like this:
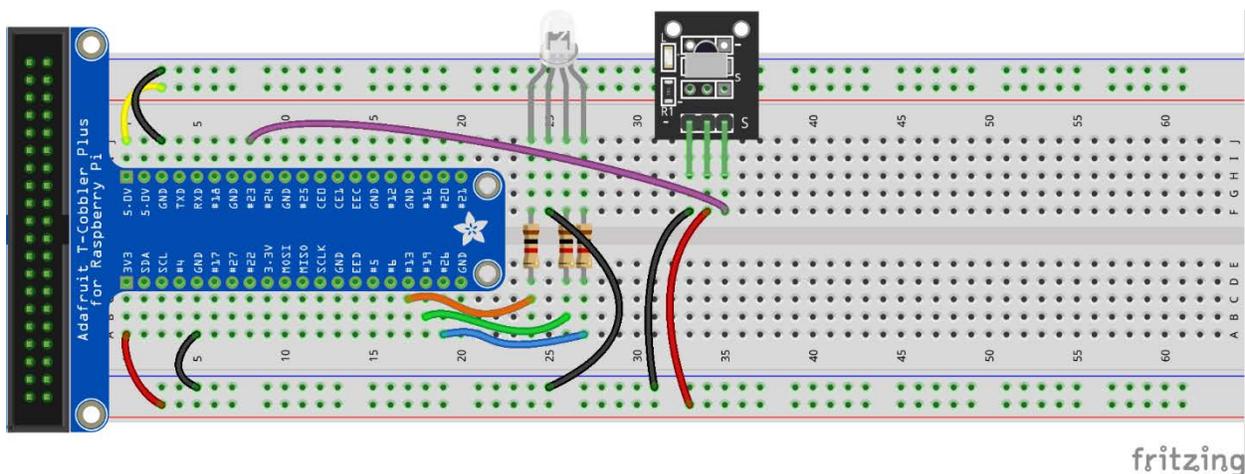
Important Tip:

The only parts of the transistor/dual-color LED circuit that should still be present on the breadboard are the 5V and ground wires in Row 3 of power rails P2 and N2. Ensure these are present on the breadboard before proceeding, as they will be required for supplying 5V to the amplifier.

Step #2

The next step will be to install the short jumper wires that will supply power and ground to the PAM8302 amplifier. There will be one connection to 5V and two connections to ground. Install three short jumper wires between the locations below:

5V - Short jumper wire – between J42 and P2-42

GND - Short jumper wire – between J41 and N2-42

GND - Short jumper wire – between J44 and N2-45
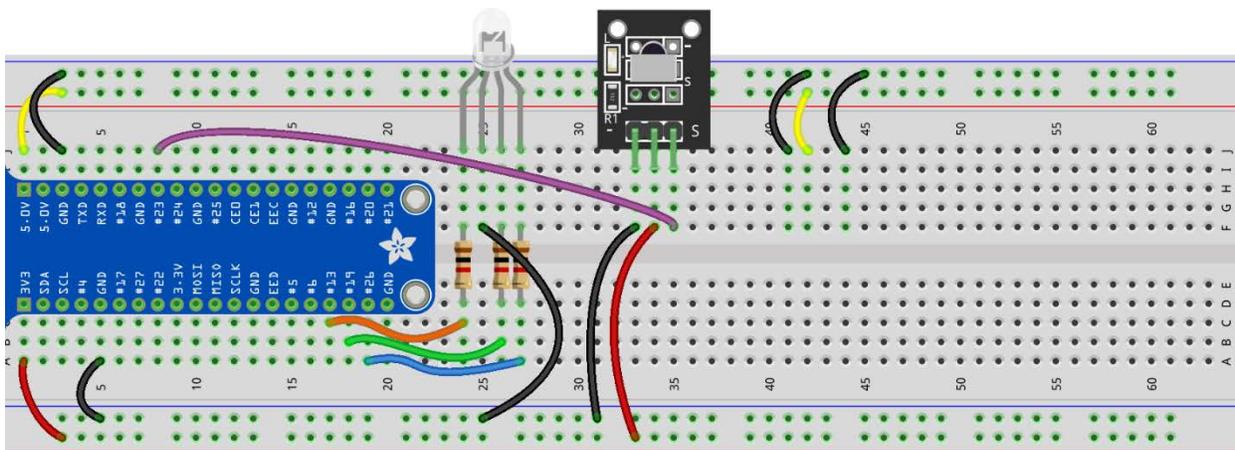
Step #3

You will need to get audio from GPIO18 over to the A+ input of the PAM8302. Install a long jumper wire between the locations below:

Long jumper wire – between J6 and J45
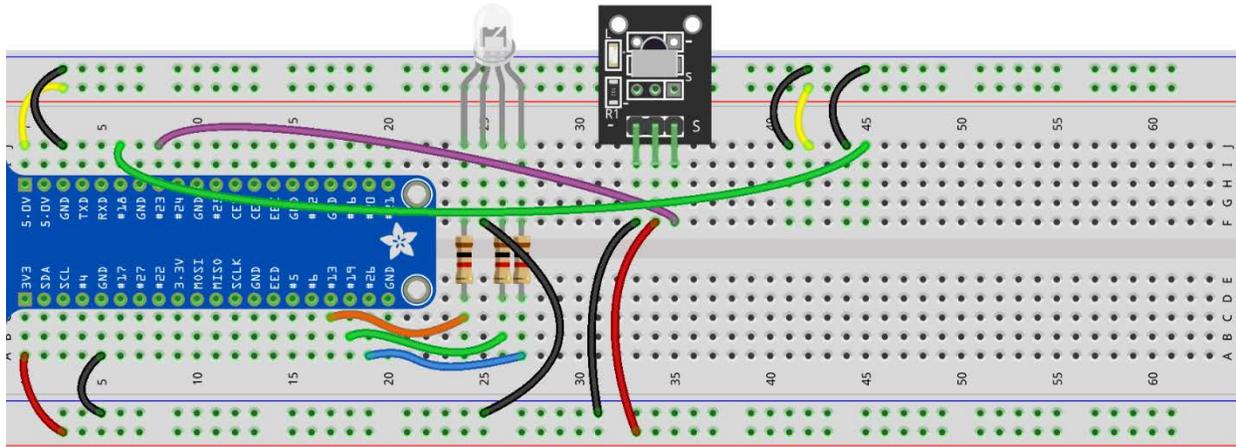
Step #4

The breadboard is now ready for the amplifier to be inserted. Insert the pins of the amplifier into the breadboard locations F41-F45. This will create connections between the amplifier and the breadboard on the following pins:

Ground – F41

Vin (5V) – F42

SD (Enable) – F43

A- - F44

A+ - F45
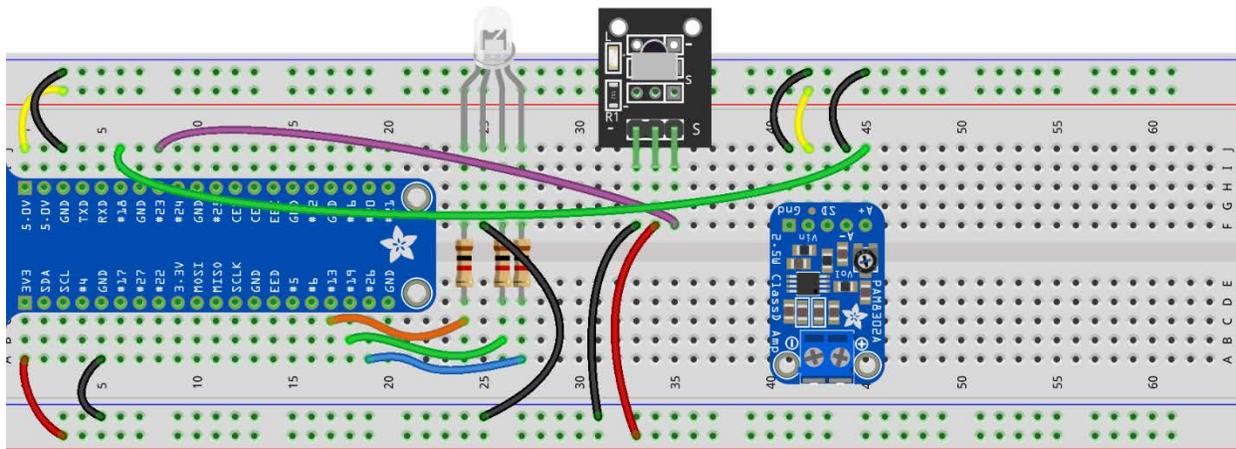
Step #5

The last step in the circuit build will be to connect the speaker wires to the amplifier. Using the small flat screwdriver from your kit, unscrew the screw clamps in the green terminal block to make space for the wires in the clamp. Insert the red wire of the speaker into the amplifier terminal marked **+**, and black wire of the speaker into the amplifier terminal marked **–**. Secure the wires into the terminal block by tightening the screw clamps. Pull gently on each wire to ensure they're both secure. If either wire is still loose, repeat this process until both wires are secured in the terminal block.
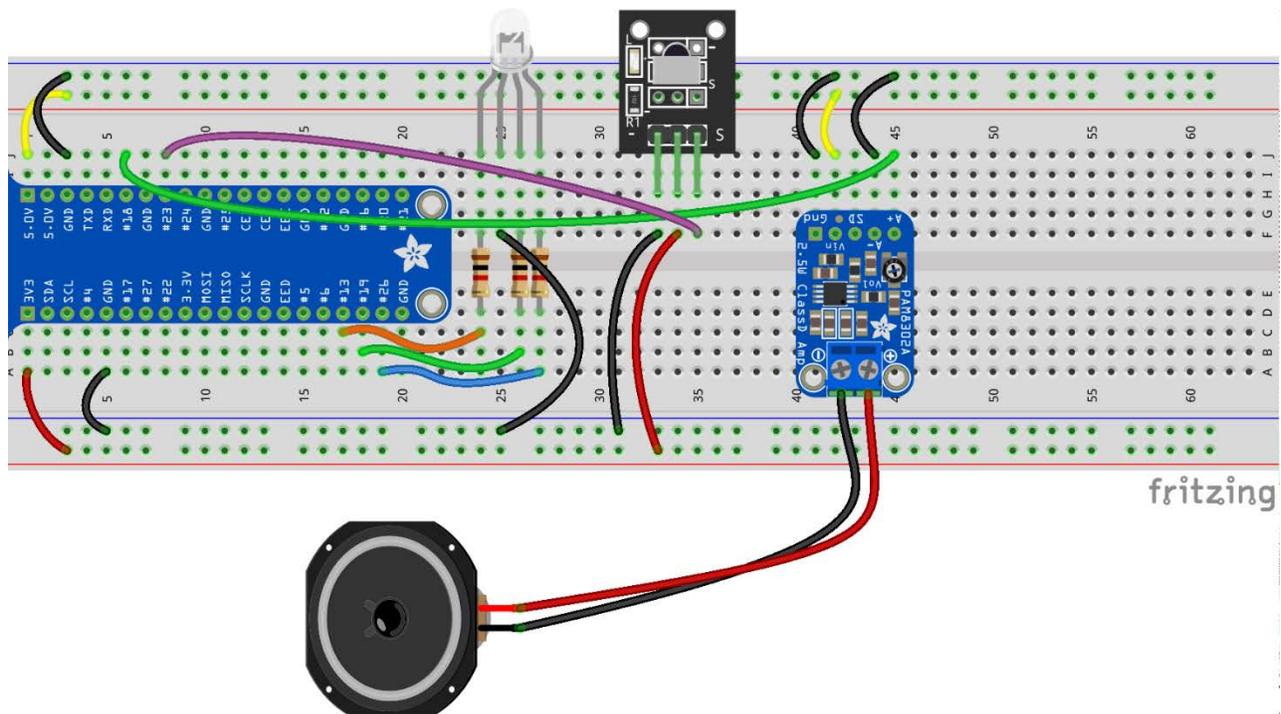
Step #6

The circuit is now ready to play audio, but you will need an audio file to play. Power up your Raspberry Pi and open up a Terminal window. In the terminal window, type the following command to download a test sound file from the 42 Electronics Level C GitHub repository:

```
curl https://raw.githubusercontent.com/42electronics/level_c/master/lesson_6/hello_42.wav >
/home/pi/hello_42.wav
```

The sound file named **hello_42.wav** will be downloaded to the home directory in **/home/pi**.

Step #7

Now that you have a sound file, you just need to create a quick program to play the sound. Open Thonny and create a new program. Use Save As in Thonny to save the program as **audio_test.py**. This program will import the **os** module, set GPIO18 as a PWM output with left channel audio, use **aplay** to play the test sound file, and then set GPIO18 back to its default input state. Add the following code to your program:

```
import os

os.system("gpio -g mode 18 ALT5")
os.system("aplay /home/pi/hello_42.wav")
os.system("gpio -g mode 18 in")
```

Once complete, run the program. You should hear the audio file playing through the speaker. If not, check the volume level and output device using the audio icon in the upper-right menu bar:

- Left-click for the volume slider
- Right-click for input options. Make sure the selected output is Analog, as this is the setting used to get audio to the 3.5mm audio jack, and GPIO18.

If you still have no sound after checking the settings above, double-check your wiring and the program. Ensure that you can properly play sound through the speaker before proceeding to the next step.

Step #8

The USB audio device that you will connect in Activity #2 will need the latest drivers to operate properly. While the Pi is still powered up, let's run an update/dist-upgrade to get all software on the Pi up to the latest version.

Use the Terminal window from Step #6 to run the command below:

```
sudo apt-get update
```

Once your Pi has downloaded the latest version numbers for all available software, run the following command to apply the software updates:

```
sudo apt-get dist-upgrade
```

Answer **y** if you're asked about using more disk space on the Pi. New software updates may introduce additional prompts during this process, so follow on-screen instructions to navigate through any other prompts that may come up during the update process.

Proceed to Activity #2 once your Pi is fully up to date.