D E S I G N G A R A G E

PEOPLE AND PLACES 01: Contact microphone and Microphone amplifier

Prof. Shannon McMullen | Prof.Fabian Winkler

Saturday, November 14, 2015
10:00 am – 1:00pm

> *How does sound define a place?*
> *How can sound be used as a way to understand and tell stories about the environments we live in and the people we live with?*

In this Design Garage workshop, we will build contact microphones and simple amplification devices that will allow us to record audio vibrations through contact with solid objects. The audio we each create will be uploaded to an online library (https://purr.purdue.edu/projects/designgarage) that participants can access to create sound compositions in Workshop 02 (December 5, 2015).

The technical component of this workshop is adapted from two great projects originally published in MAKE magazine:

(1) Building a contact microphone:
http://makezine.com/projects/make-38-cameras-and-av/piezo-contact-mic/

(2) Building a contact microphone amplifier:
http://makezine.com/2011/12/20/collins-lab-diy-contact-mic/

After building our contact mics, we will experiment with creative production. In the context of this workshop, we are interested in recording sounds of places and people that are interesting/important/strange/uncommon/etc. to us. Directions for uploading,

annotating and sharing the sounds to a shared database will be covered in this workshop.

Join us for workshop 2 on December 05, 2015 to learn audio editing techniques for arranging and composing creative sound portraits using material from the database.

Technical Workshop 01:
Building a Contact Microphone and Microphone Amplifier

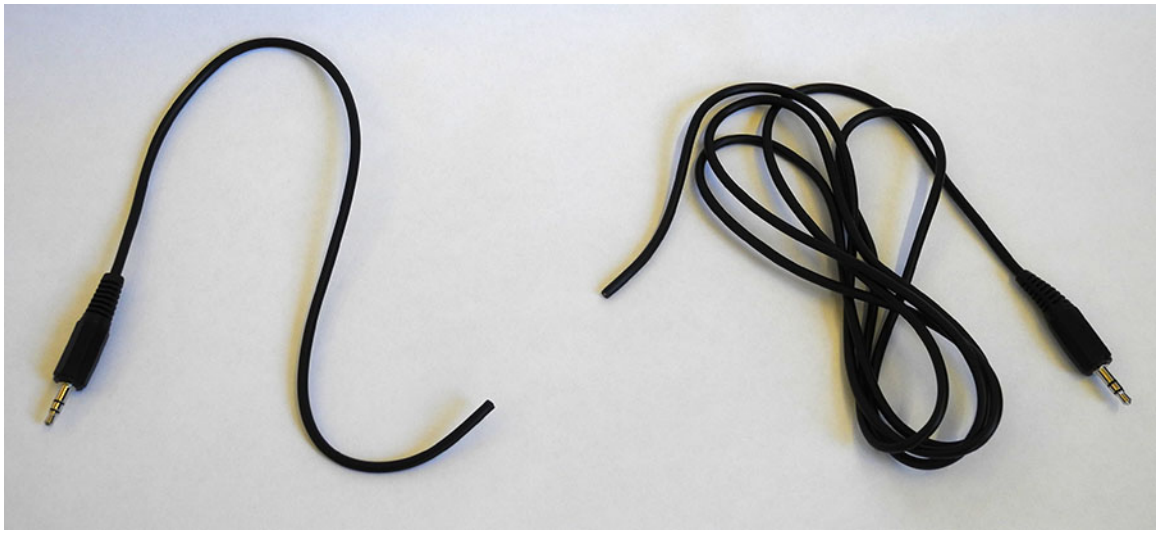
What is a contact microphone?
Rather than recording sound as vibrations in the air around us (this is what a regular air microphone would do), a contact microphone senses audio vibrations through contact with solid objects. This type of microphone is thus almost completely insensitive to air vibrations.

How do I build one?
Parts list:

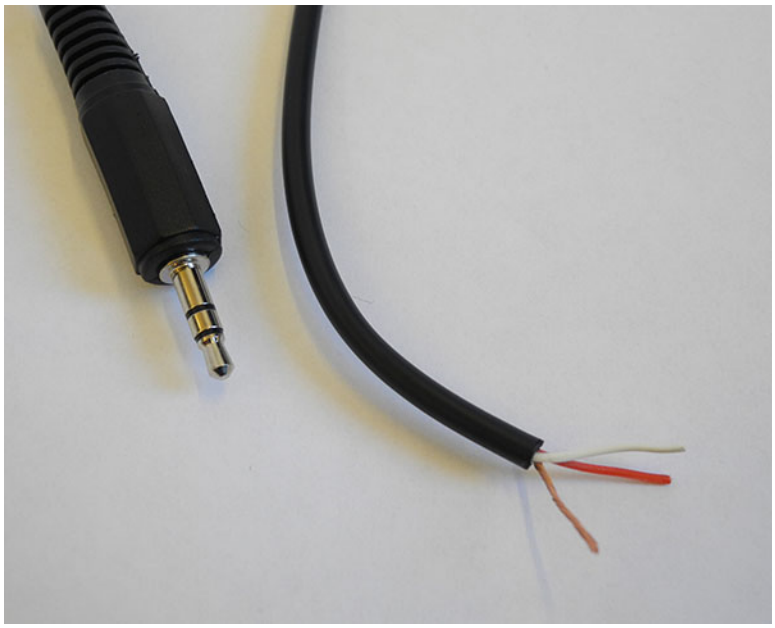
- audio cable with 3.5mm plugs
- piezo disc
- soda with metal twist of bottle cap
- plasti-dip

Steps:

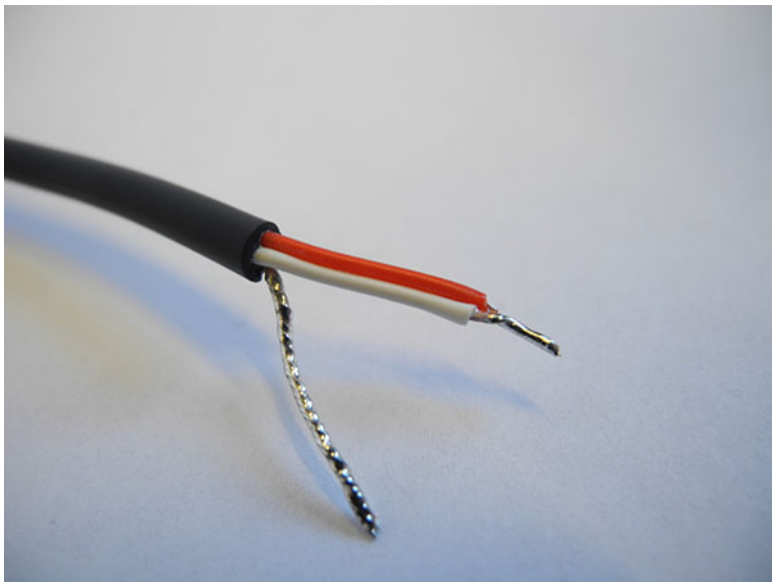
(1) Cut the audio cable, approx. 12 inches in. You should have one longer end and one shorter (12 inch) end:



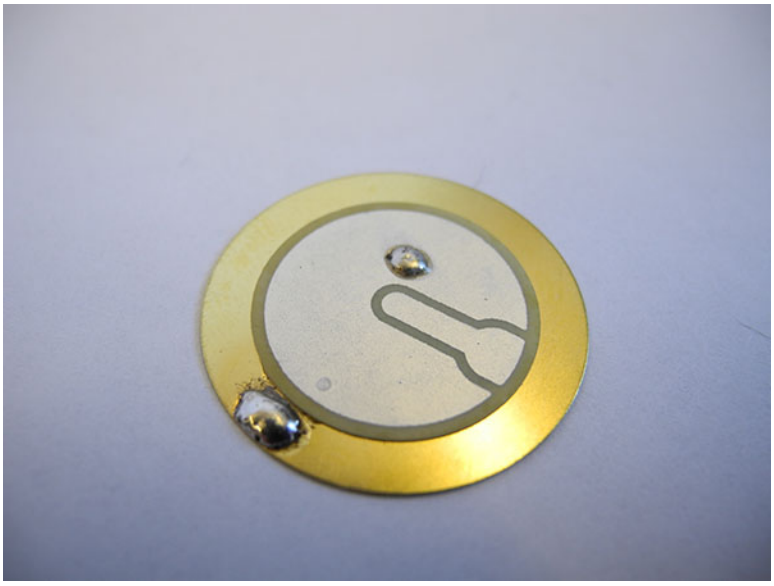
(2) For each of the two cable pieces, take off approx. 0.5in of the cable's insulation, twist together the copper strands:



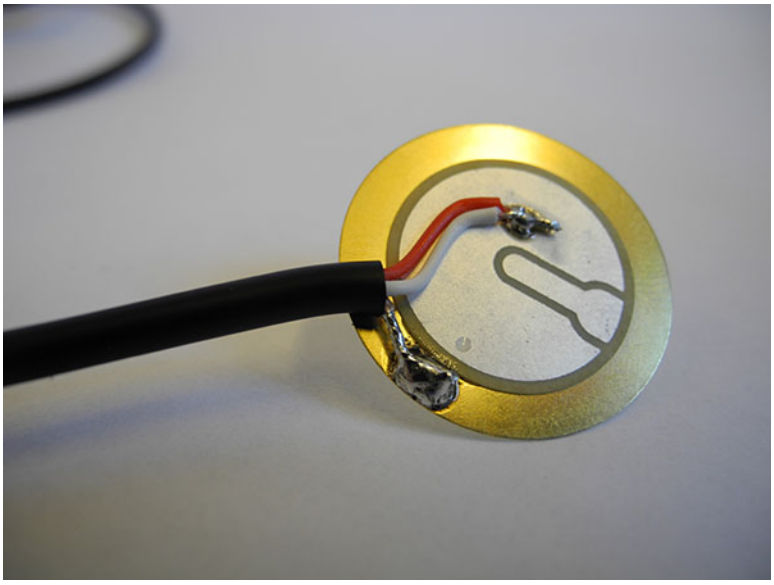
(3) Strip off approx. 1/16in of the insulation of the white and the red wire, twist the exposed ends of the white and red wire together and cover with solder, also cover the copper wire with solder – do this for both cable ends:



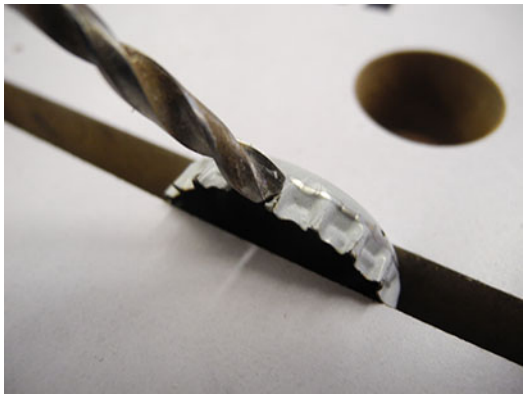
(4) Put two dots of solder on the piezo disc. One on the brass ring on the outside (scratch the spot where you want to solder a bit with the tip of a screwdriver, the rim is covered with some resin that needs to be scratched off) and one in the middle (white area - here, apply heat with solder iron only very shortly, this surface burns easily). Also wait 30 seconds or so after soldering before you touch the disc, it may still be very hot!

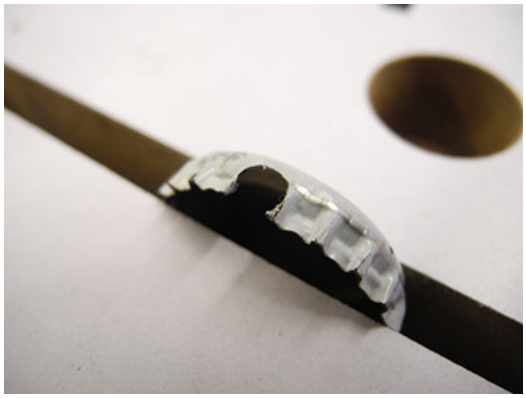


(5) Now solder the longer cable to the piezo disc (reserve the 12 inch shorter cable for later) – the red and white wires go to the white crystal surface in the center, the uninsulated wire goes to the outside rim:



(6) Take the metal bottle cap and drill a small hole (5/32 drill bit) into its side. Make sure to safely clamp down the bottle cap and drill slowly so that the drill bit does not slip off the bottle caps' rim:





(7) Put some hot glue around the outside rim of the piezo disc and glue the bottle cap to it. You may have to work fast so that the hot glue does not harden before you can put the bottle cap on.

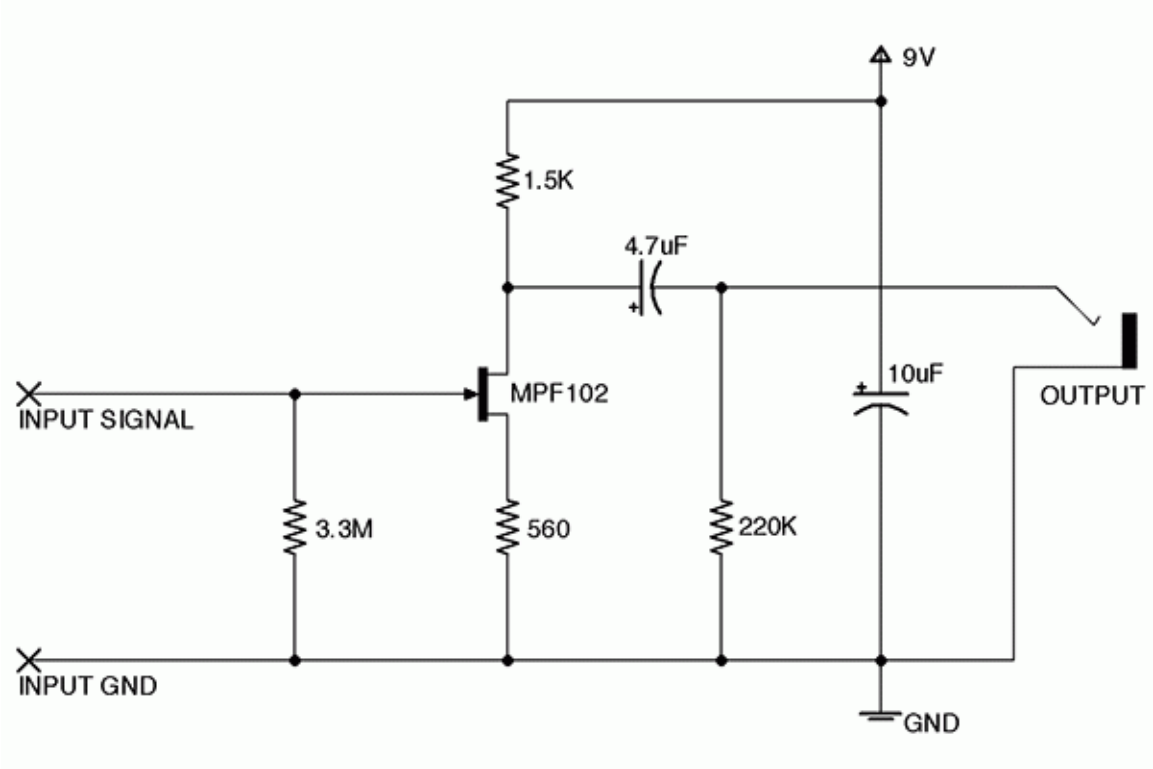
(8) Finally, dip the bottom (piezo side) of the contact microphone into some plasti-dip and seal around the cable opening on the bottle cap. This makes the microphone water-tight and dampens the microphone's high frequency response a bit.

How do I build a contact microphone amplifier?
At this stage, connecting only the contact microphone to an amplifier or recording device may sound a bit tinny. The contact microphone preamplifier that we are going to build in the next step will even out the impedance and provide a small volume boost, giving you a more natural sound and less emphasis on the higher frequencies.

Parts list:

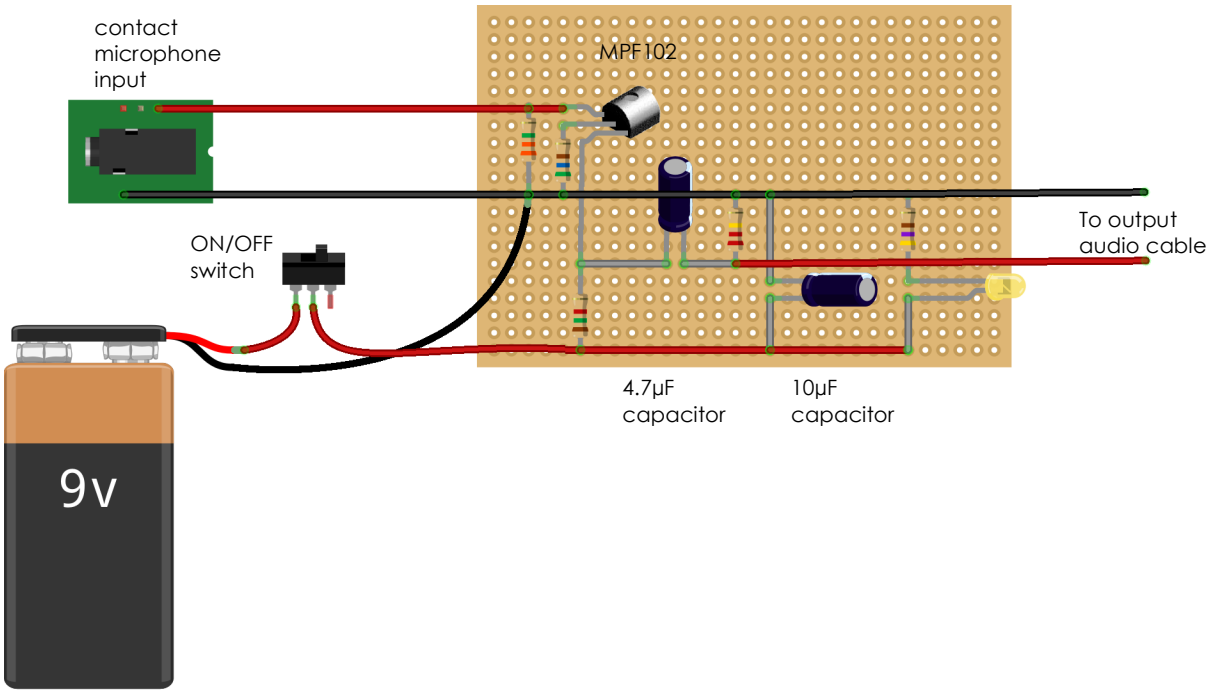
- 9V battery
- 9V battery clip
- toggle switch
- MPF102 N-Channel RF Amplifier
- 3.5mm audio jack
- audio cable with 3.5mm plug
- resistors: 470Ω, 560Ω, 1.5kΩ, 220kΩ, 3.3MΩ
- capacitors: 4.7µF, 10µF
- LED, 3mm
- Project box
- Printed circuit board

Circuit Diagram:



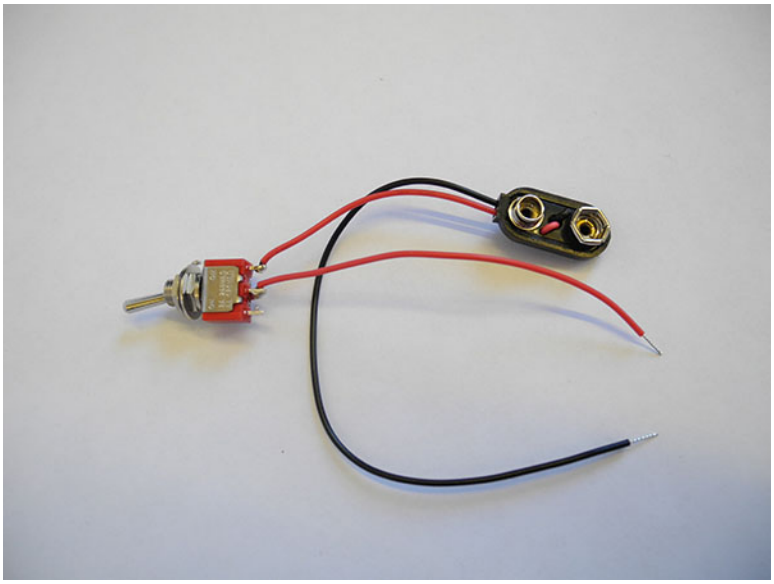
From Colin's Lab: http://makezine.com/2011/12/20/collins-lab-diy-contact-mic/

And this is how the circuit diagram translates into a circuit you can solder on your printed circuit board:

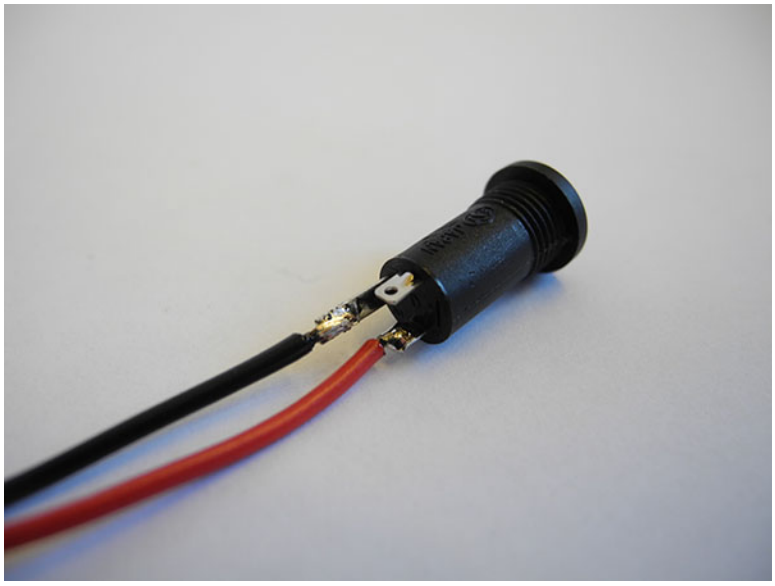


Steps:

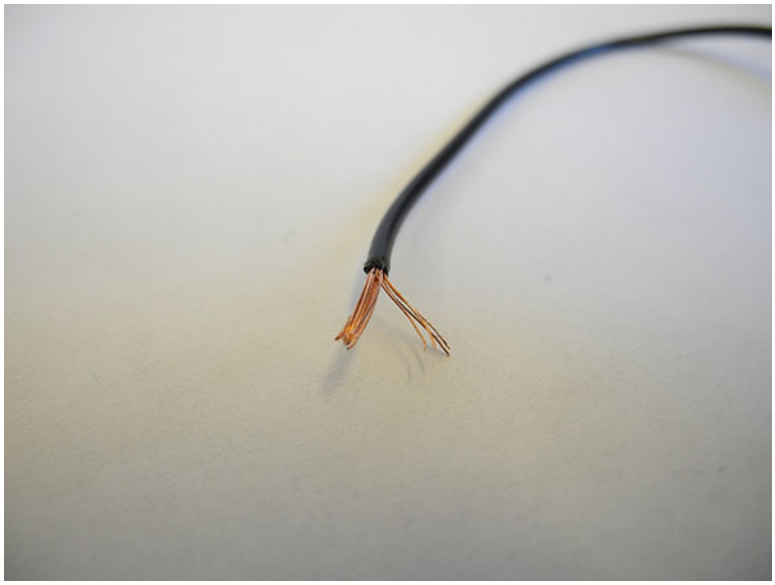
(1) Prepare the ON/OFF toggle switch and 9V battery clip, cut half of the red wire of the battery clip and solder it onto the toggle switch contacts like this:



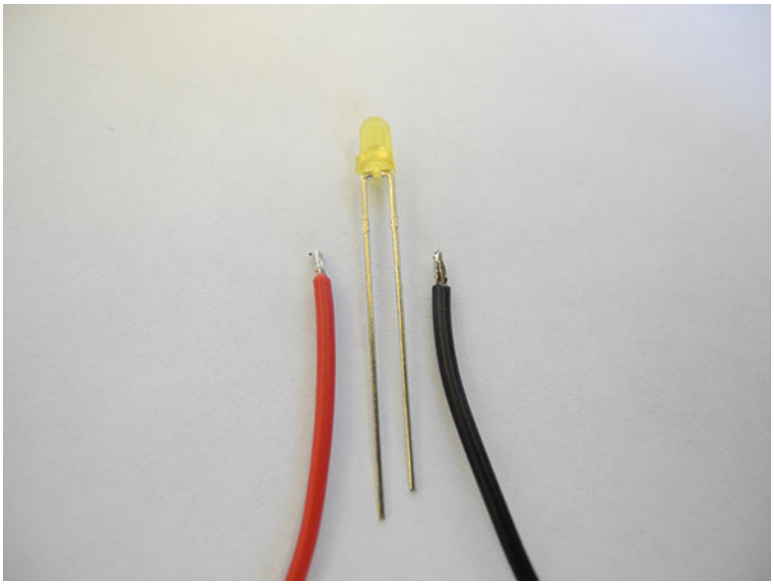
(2) Solder a red and a black wire to the audio jack, like shown in the picture below. The red wire will connect to the audio signal from the contact microphone, the black wire will connect to ground (GND).



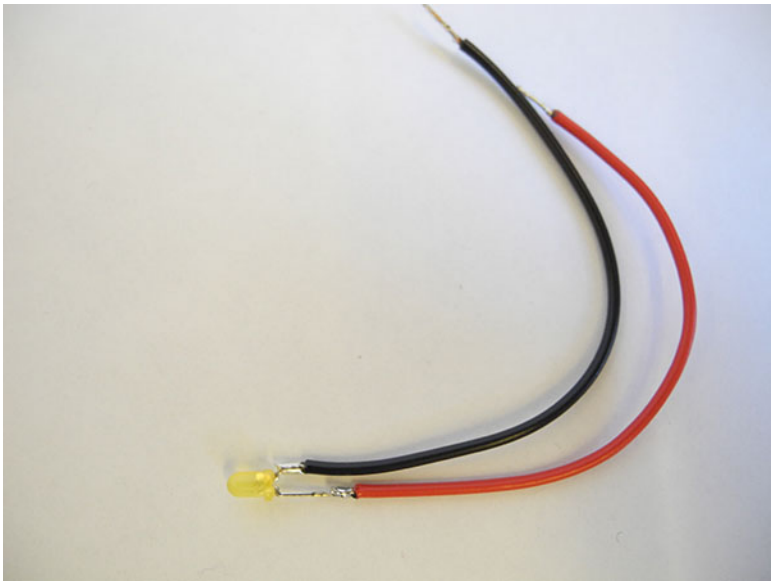
It is a good idea to "thin out" the ends of the wires that are not soldered to the jack before tinning them. Just separate 3-5 strands of the exposed end and cut them off before testing the rest of the strands together and covering them with solder. This way they will fit better through the PCB holes.



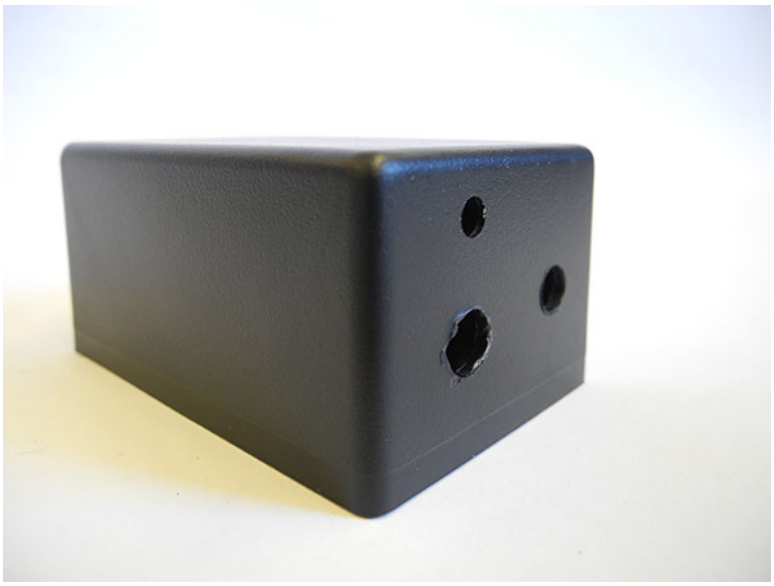
(3) Now prepare the LED, it has a longer leg (goes to + voltage in circuit) and a shorter leg (goes to GND). In electronic circuits, black wires usually lead/connect to ground and red wires go to the positive operating voltage.



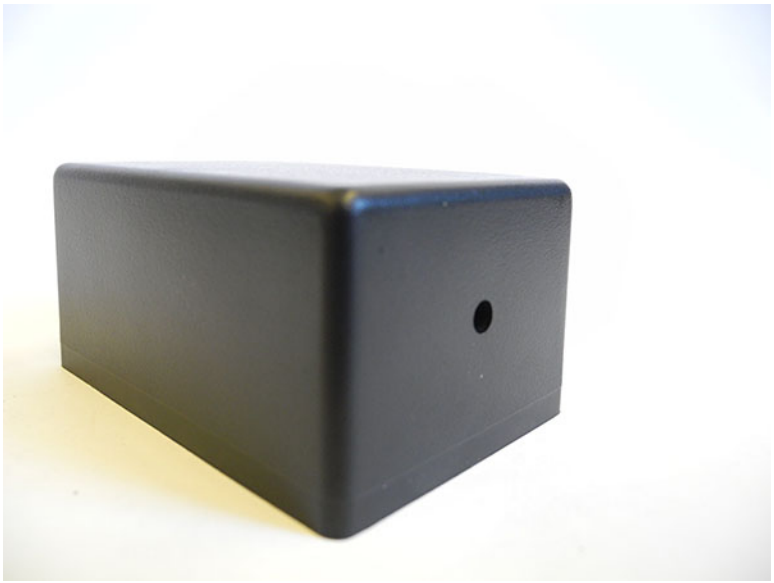
Solder the red wire to the LED's long leg and the black wire to the LED's short leg, cut the legs first, to have only very little unexposed conductors:



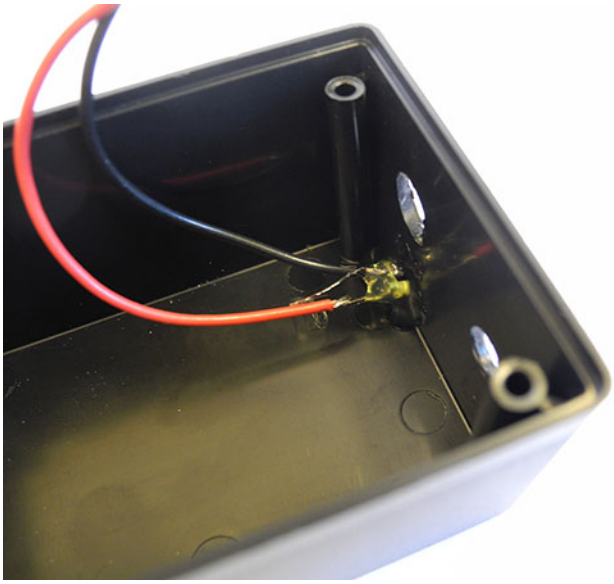
(4) In this next step we prepare the project box, so we can mount the LED, switch and audio jack. You can place components where you like, as long as you make sure that the 9V battery and the circuit will still fit inside the box. I found that the following arrangement worked well in my case:



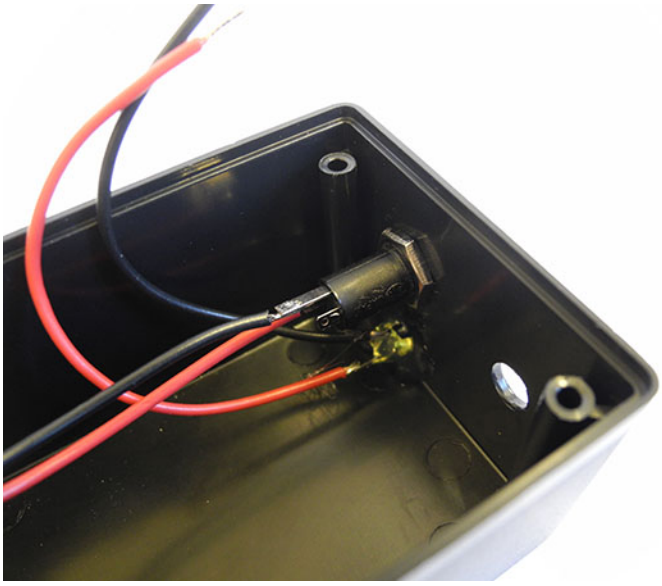
The holes for the components were drilled with the following bits: ¼" for the toggle switch, 5/16" for the audio jack and 11/64" for the audio cable out (on the opposite side of the box, see below).



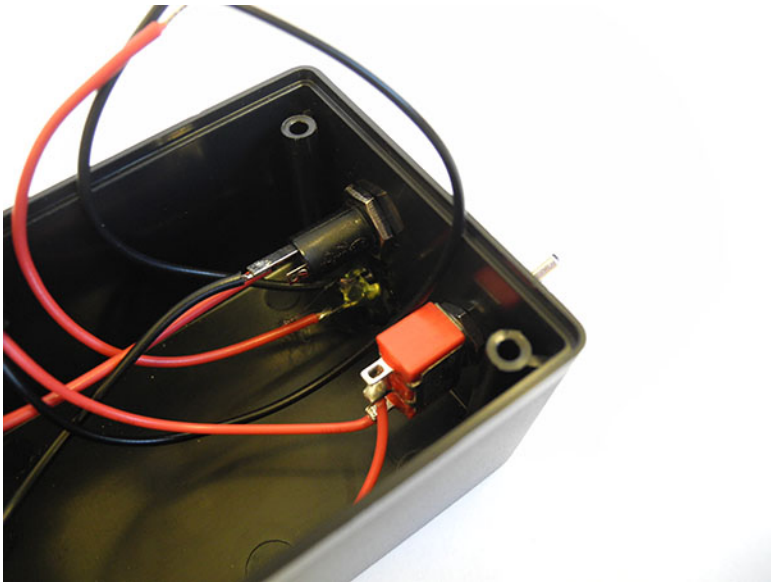
(5) Now we can install the prepared components in the box. I start with the LED. You can secure the LED from the inside of the box with some hot glue.



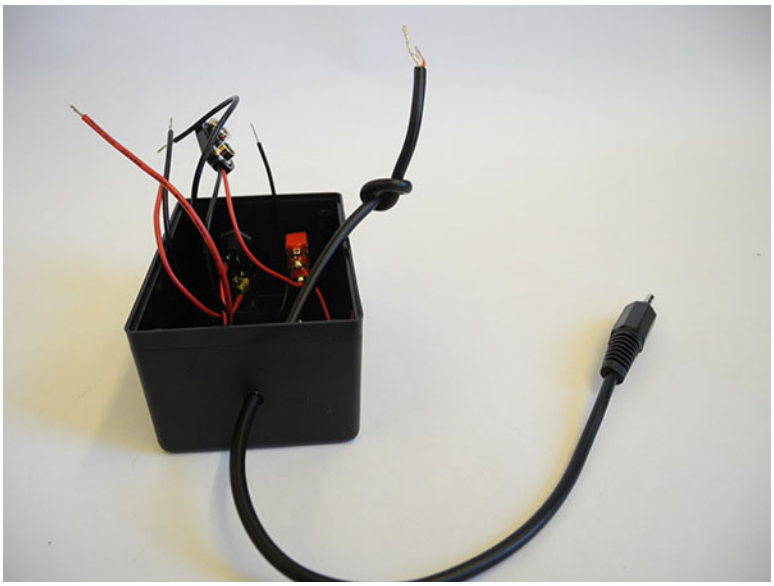
Then attach the audio jack:



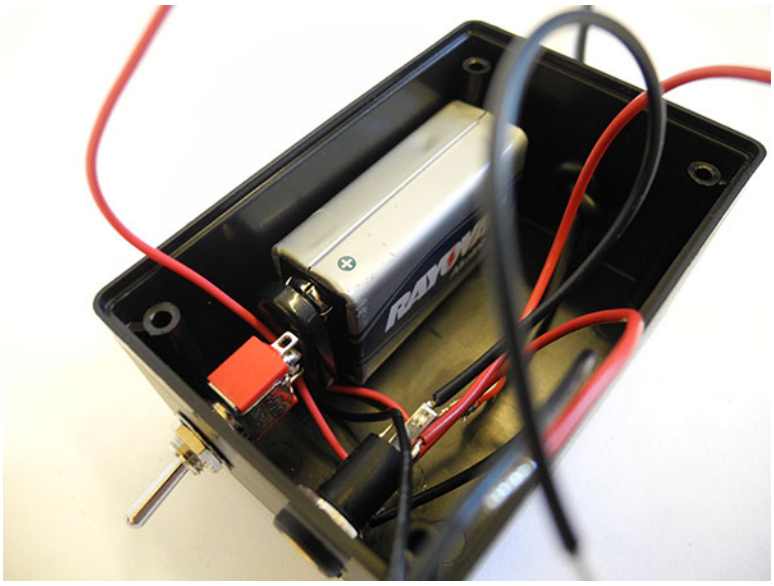
And then the toggle switch:



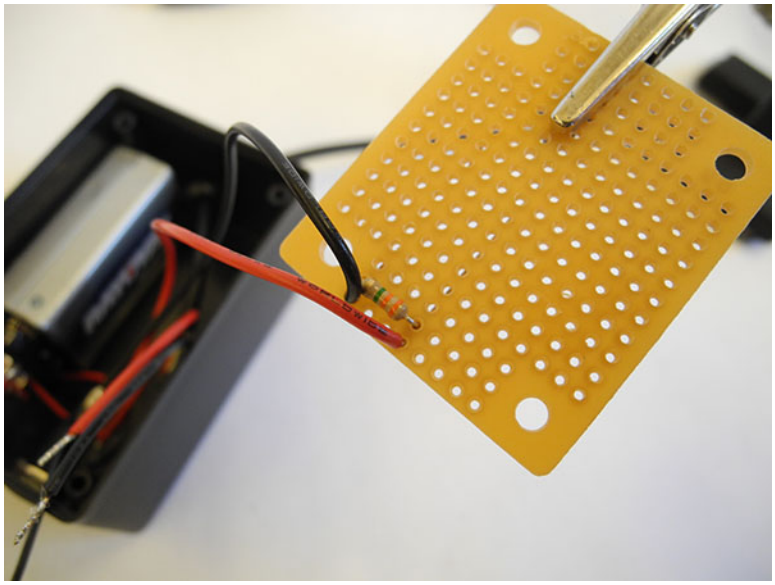
On the other side of the box insert the 12 inch long audio cable. Tie a knot into the cable as a strain relief on the inside of the box:



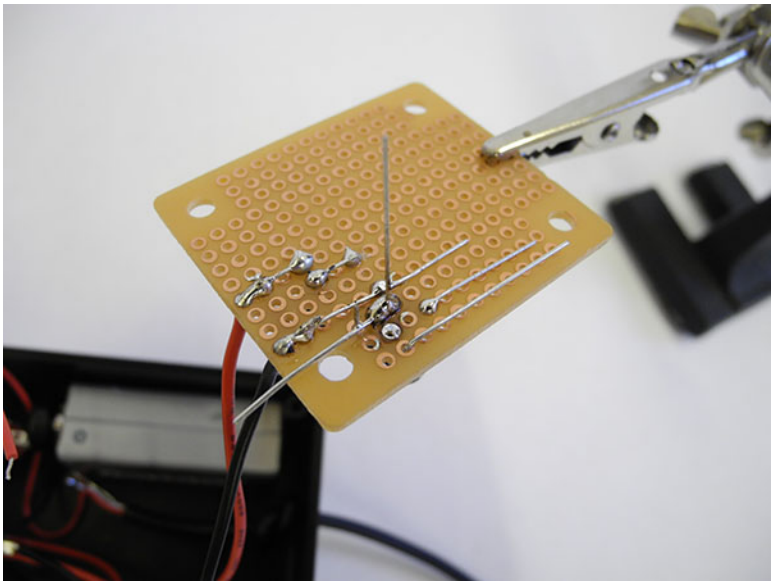
(6) You can now already connect the battery to the 9V clip. Just make sure that the toggle switch is in the OFF position (you can use a multimeter to double check that it is OFF).



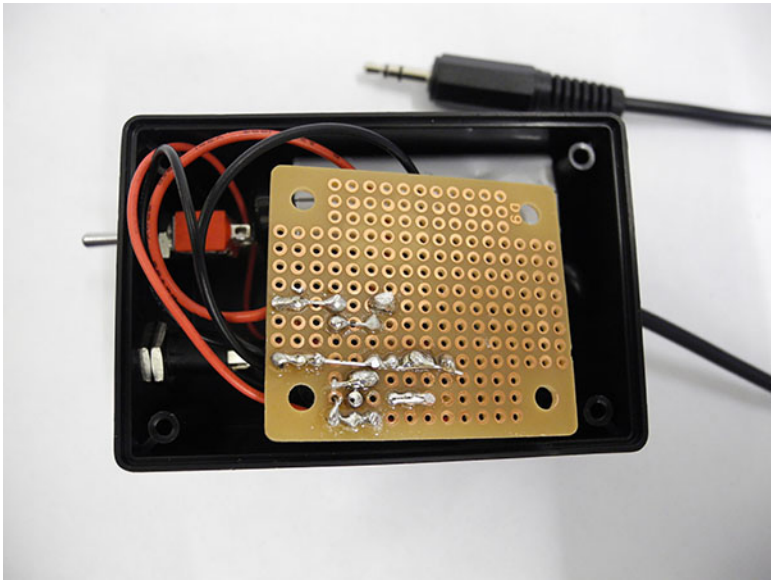
(7) It is now time to solder the preamplifier circuit on the printed circuit board, start with the wires coming from the audio jack:



Use the circuit from page 7 to see how parts connect on the printed circuit board. Try and build everything on one side of the circuit board, so that the circuit fits next to the 9V battery in the project box. Also, as a building tip: use the legs of components on the underside of the printed circuit board to make connections like this:



Finally connect the LED, the audio output cable and the 9V battery to the proper components on the circuit board. It is now time to try out the preamplifier circuit with the contact microphone and a sound recording device (see picture on the first page). If everything work – congratulations! You can close up the project box and start with your recording ideas. If there is no sound coming out of the circuit, or if it is distorted or with a humming noise – go back to the circuit on page 6/7 and compare and double check each connection with your soldered circuit. It helps to cross off components/connections on the print out when you have checked them on your circuit board.



How do I record sounds with my contact microphone?

iPhone/Smartphone:
http://www.bhphotovideo.com/c/product/813396-REG/Sescom_IPHONE_MIC35_1RA_iPhone_iPod.html

Note that some smartphones (Android-based not iOS) allow you to plug your contact mic/amplifier directly into the audio jack and record sound.

Computer without microphone input:
https://griffintechnology.com/us/products/audio/home-audio/imic

Audio recorders:
ETB has a variety of portable audio recorders with microphone input jacks that allow you to record sounds with your contact microphone/amplifier. The advantage of these recorders is that they also have built-in air microphones that allow you to record sounds the traditional way:

- ZOOM H2: http://www.samsontech.com/site_media/legacy_docs/H2_user_manual.pdf
- ZOOM H2: http://www.samsontech.com/site_media/support/manuals/E_H2n.pdf
- ZOOM H4n: http://www.zoom.co.jp/download/E_H4n.pdf

Some Sound Recording Artist Examples

- Hildegard Westerkamp: http://www.sfu.ca/~westerka/compositions.html
  - https://www.youtube.com/watch?v=oEWN3P8EZkE (YouTube of a sound work)
  - https://vimeo.com/12479152 (Sonic Acts Lecture, 2010)

- Luigi Russolo Art of Noise
  - https://www.youtube.com/watch?v=VHLmitA3o6g
  - https://www.youtube.com/watch?v=Lqej96ZVoo8 (contemporary performance)
  - http://www.artype.de/Sammlung/pdf/russolo_noise.pdf (futurist manifesto)

- Stephen Vitiello: http://www.stephenvitiello.com/