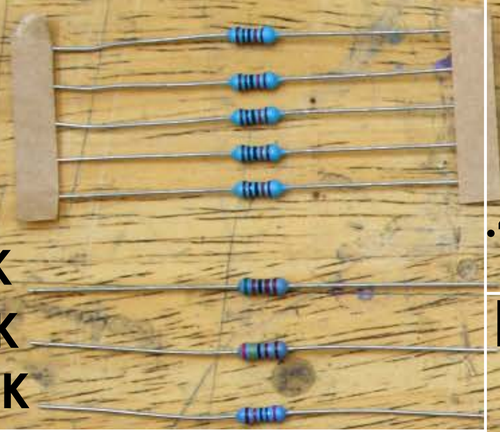
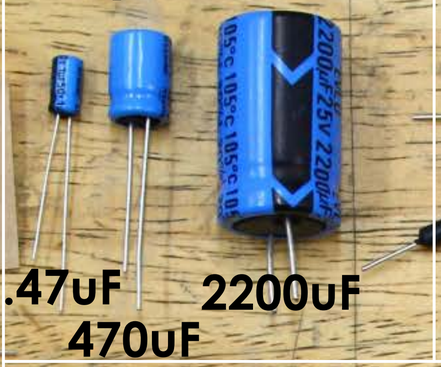
Resistors



Capacitors

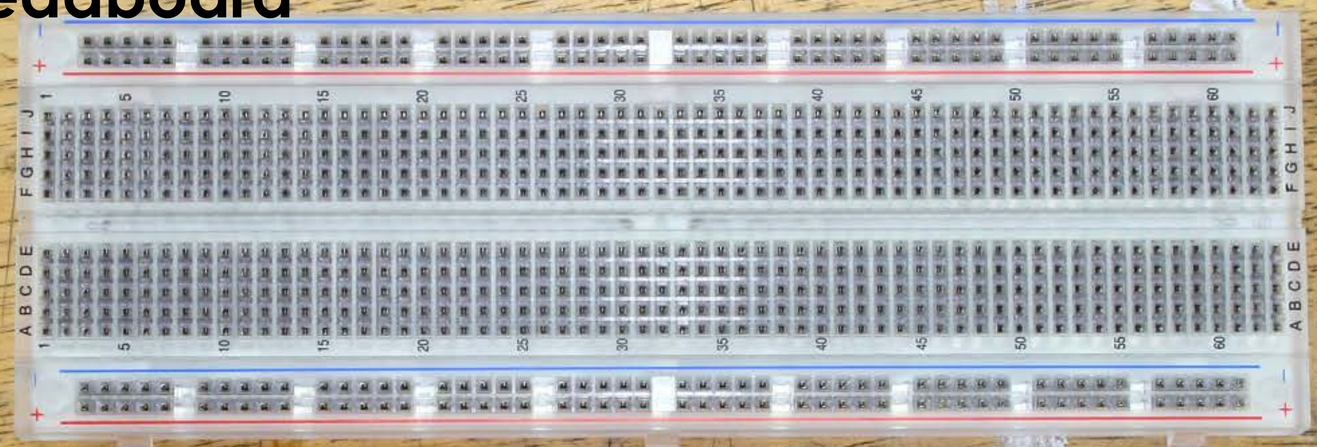


Jumper Wires

Buttons

CMOS ICs

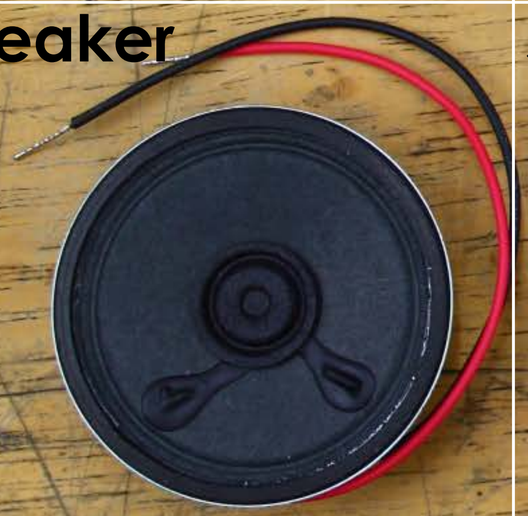
Breadboard



Not Shown:

4x LEDs
4x 1k Resistors

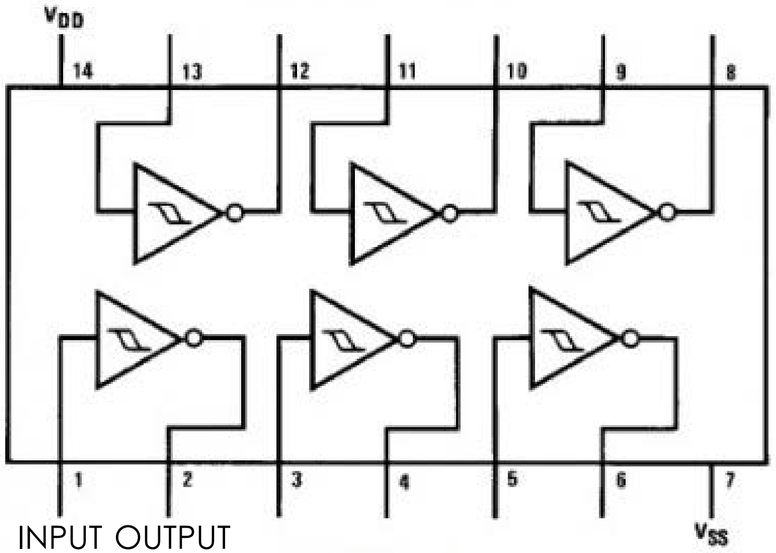
Speaker



Jumper Wires

Connection Diagram

Dual-In-Line Package



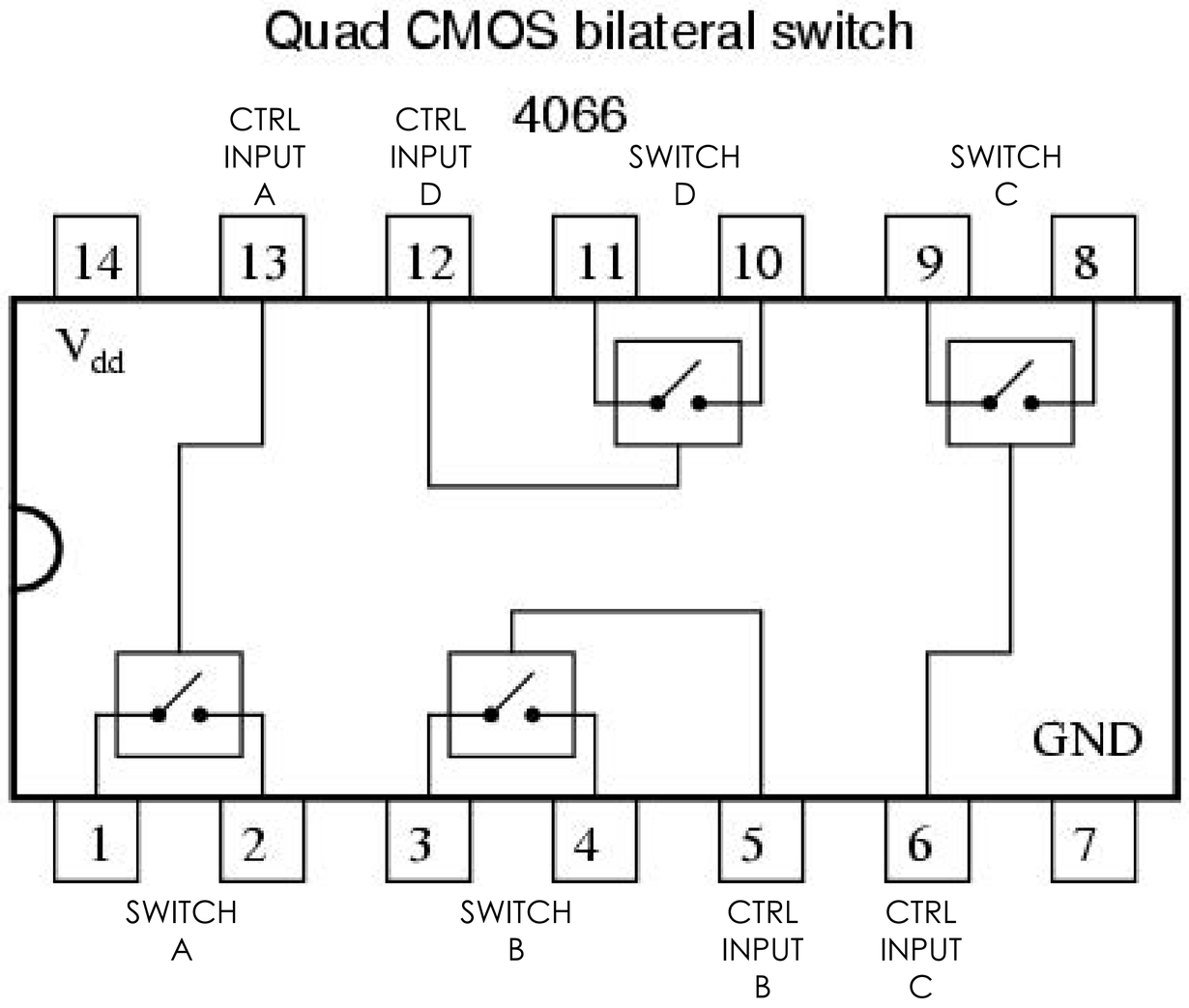
Top View

Function Table

$Y = \overline{A}$

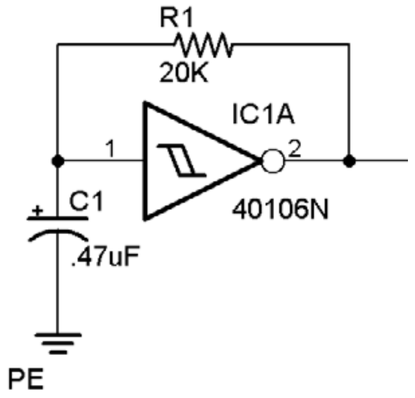
Input	Output
A	Y
L	H
H	L

H = HIGH Logic Level
L = LOW Logic Level

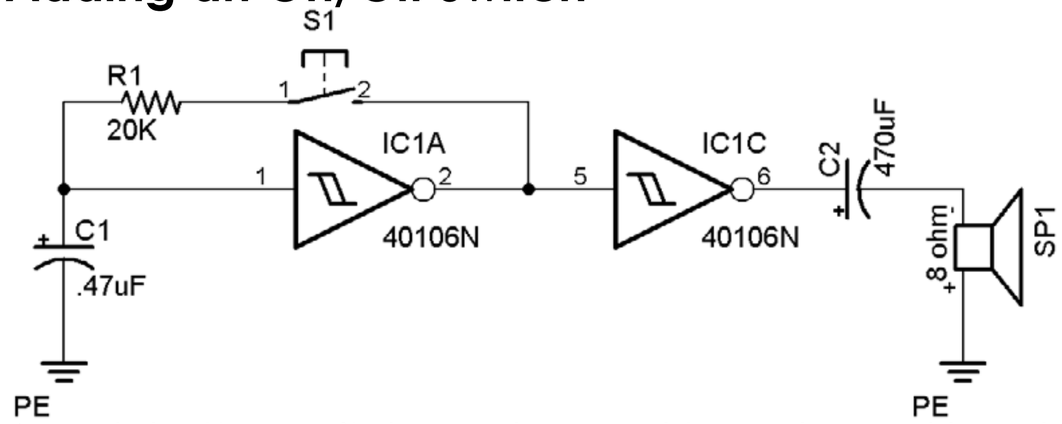


Oscillator built using a 40106 Hex Schmitt Trigger Inverter

Technical jargon aside, this oscillator is the heart of our sound making circuit. It outputs a square wave the frequency of which is dependent on the values of the capacitor and feedback resistor.

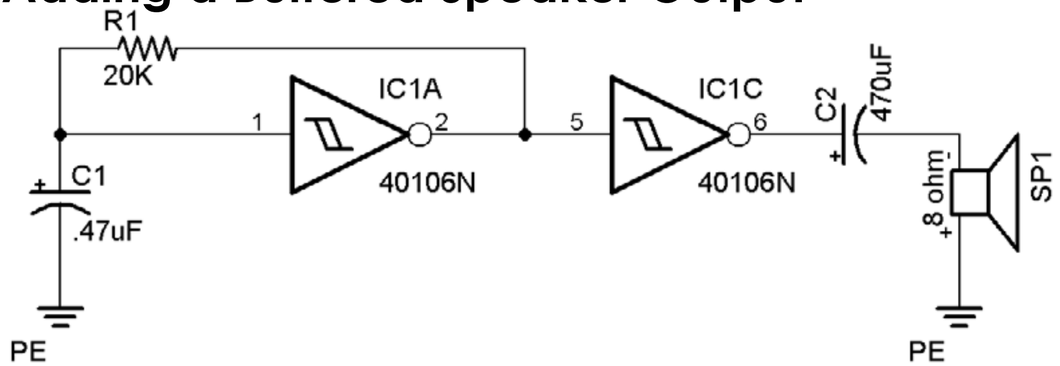


Adding an On/Off Switch



A push button switch can be used to make and break the feedback path, turning the oscillator on and off, respectively.

Adding a Buffered Speaker Output

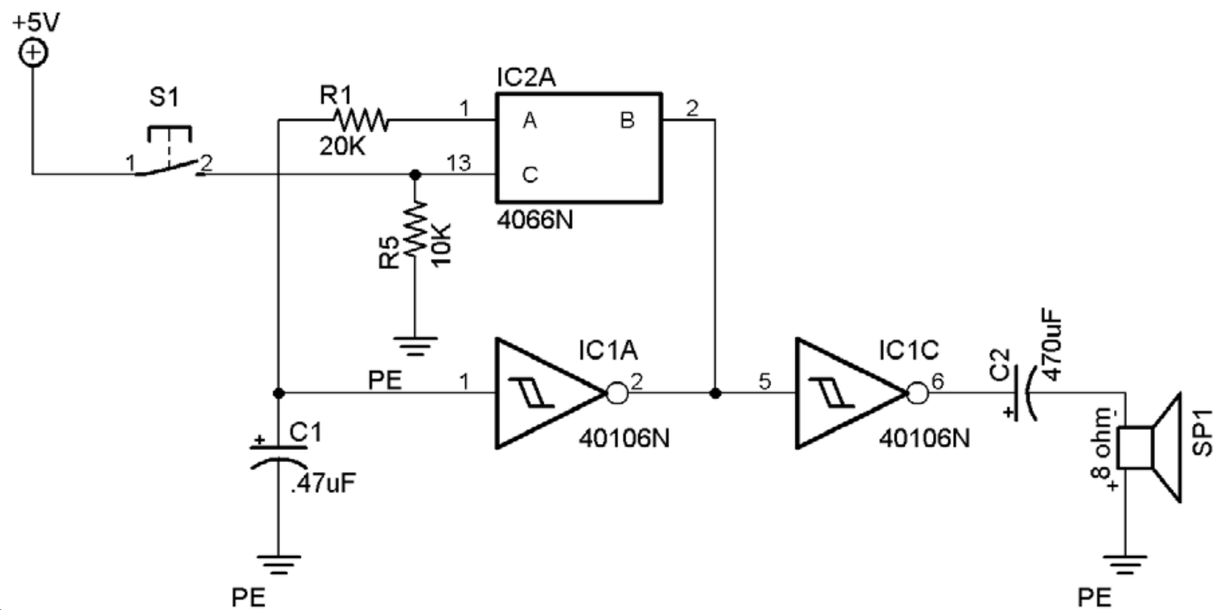


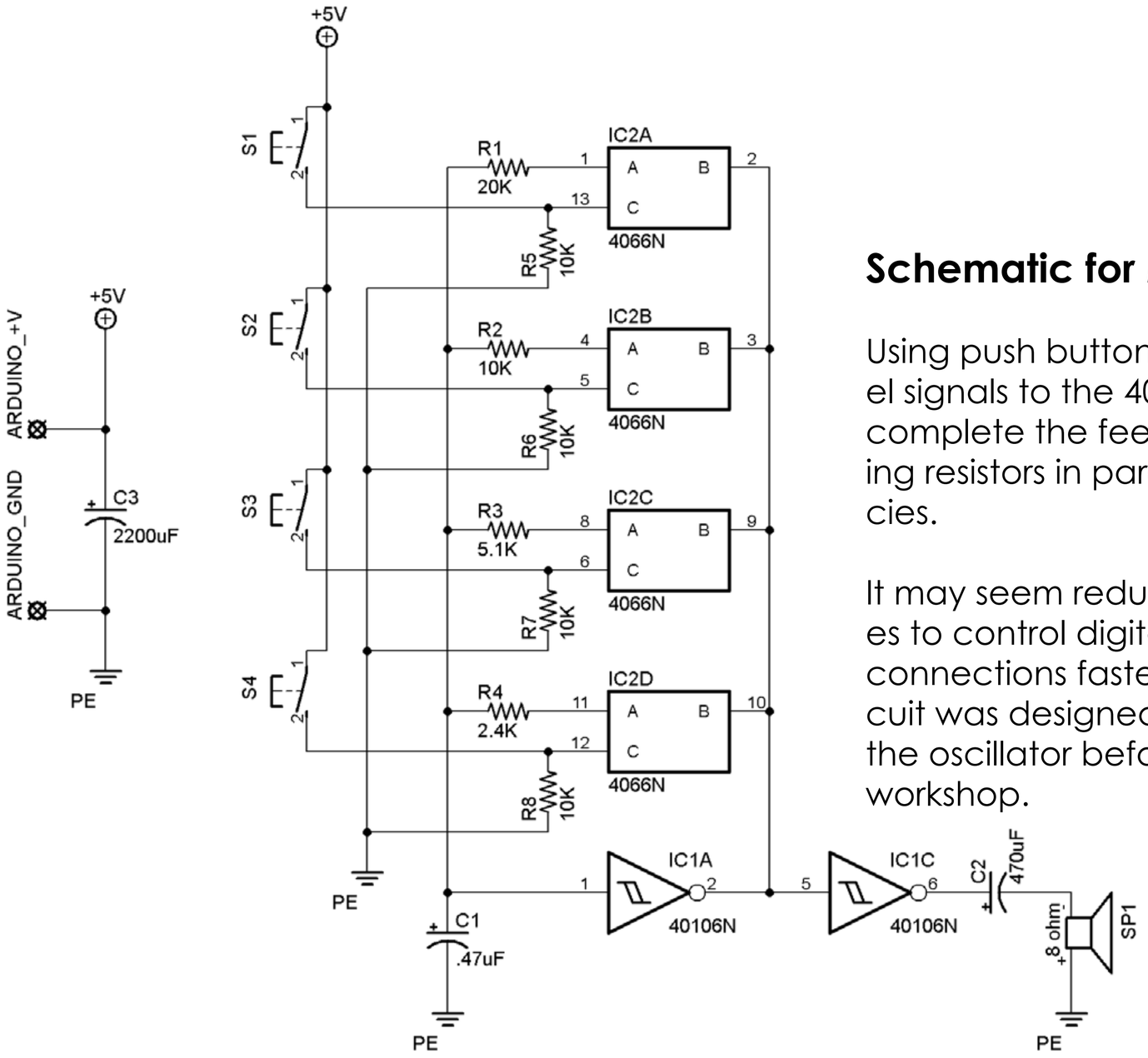
In order to listen to our oscillator, we need to electronically isolate it from the speaker. The speaker requires a lot of current to create sound and this current draw would prevent the oscillator from working if connected directly.

To buffer our oscillator and isolate it from the speaker, we simply connect the output to the input of another inverter and then use that second inverter to drive the Speaker.

Adding Digital Control with Manual Override

Replacing the push button switch with a 4066 switch, gives us the ability to digitally control the feedback path of our oscillator. In the schematic below we are using the push button switch to send logic level signals to the 4066 control pin.

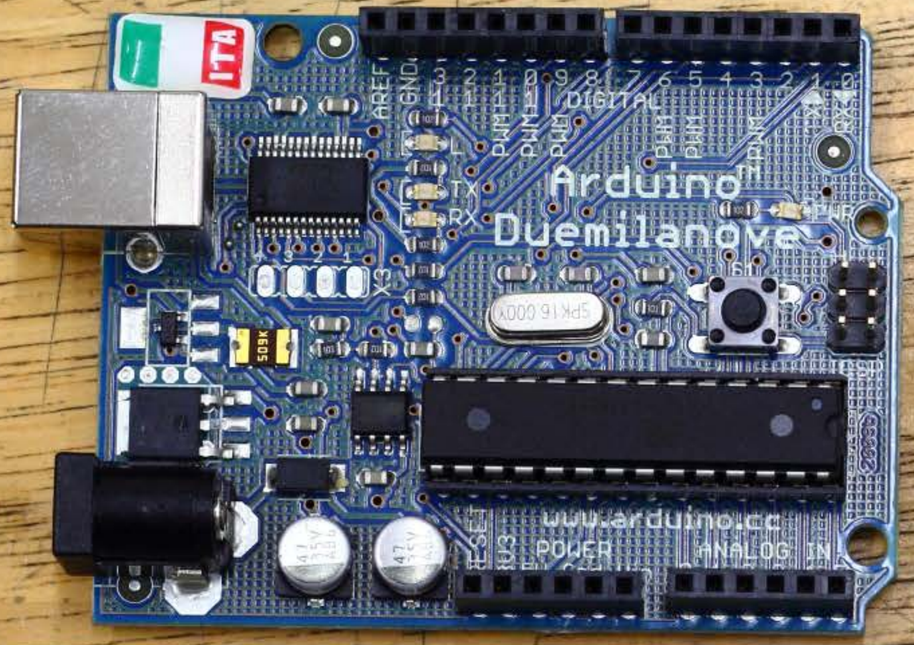




Schematic for Manual Control of a 40106 Oscillator

Using push buttons, it's possible to manually send logic level signals to the 4066 gates in order to control which resistors complete the feedback path in the 40106 oscillator. Combining resistors in parallel produces a variety of different frequencies.

It may seem redundant at this point to use manual switches to control digital ones, but the 4066 will enable us to make connections faster than our fingers could otherwise. This circuit was designed so that we could have manual control of the oscillator before we move on to digital control later in this workshop.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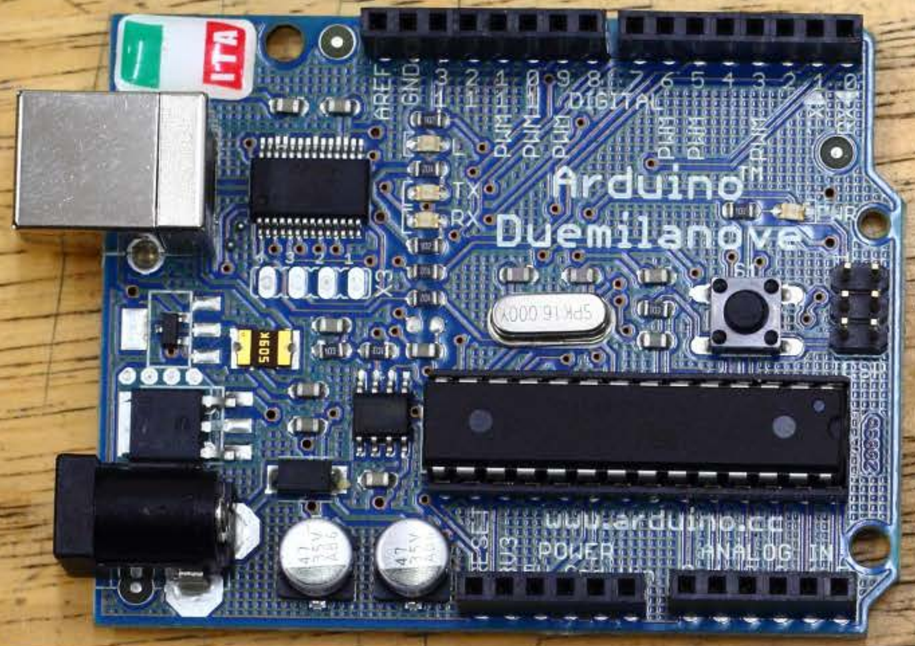
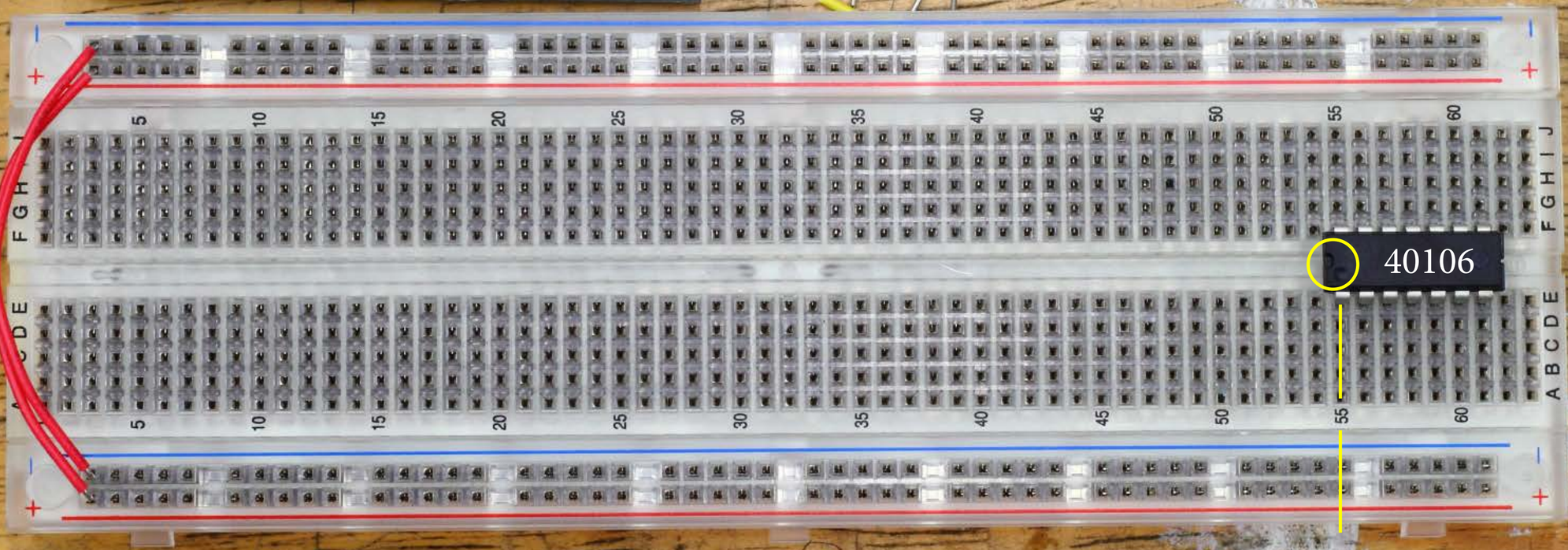
POWER
ANALOG IN

Connect + rail on top to + rail on bottom

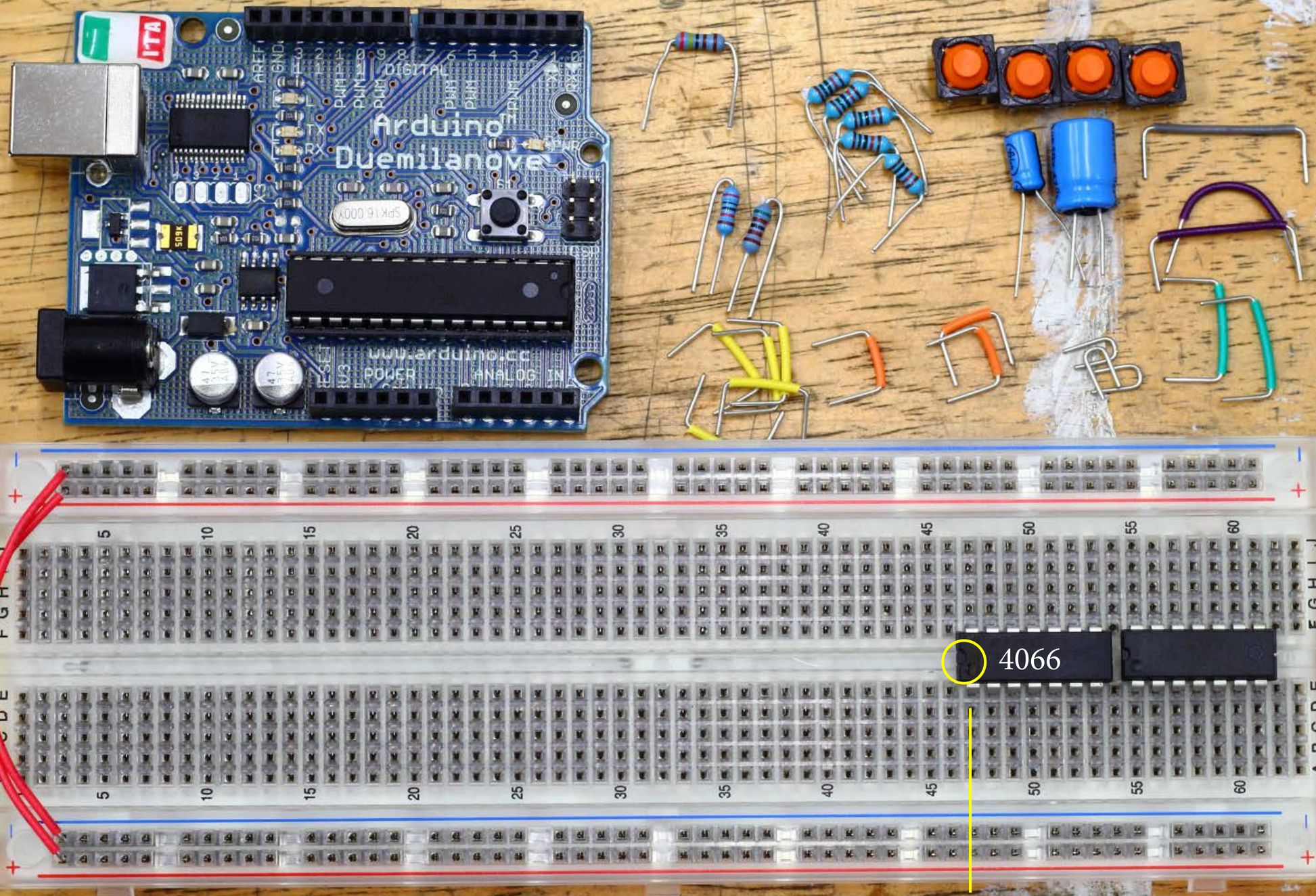
Connect - rail on top to - rail on bottom





Place the IC labelled 40106 starting on row 55

Be careful that the notch is on the left and that the print on the chip is not upside-down.



Place the IC labelled 4066 starting on row 47

Be careful that the notch is on the left and that the print on the chip is not upside-down.

Place the buttons...

Place the buttons...

Place the buttons...

Place the last button.

Place the short silver jumpers

Place the short silver jumpers

Place the last of the short silver jumpers

Place the orange jumpers

Place the orange jumpers

Place the last of the orange jumpers

Place the yellow jumpers

Place the yellow jumpers

Place the yellow jumpers

Place the yellow jumpers

Place the last of the yellow jumpers

Place the green jumpers

Place the last of the green jumpers

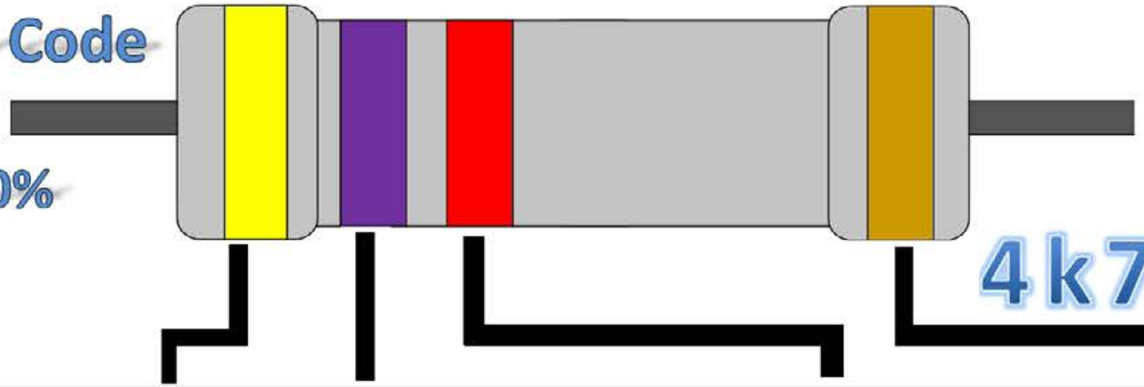
Place the violet jumpers

Place the last violet jumper

Place the gray jumper

4 – Band Code

2%, 5%, 10%

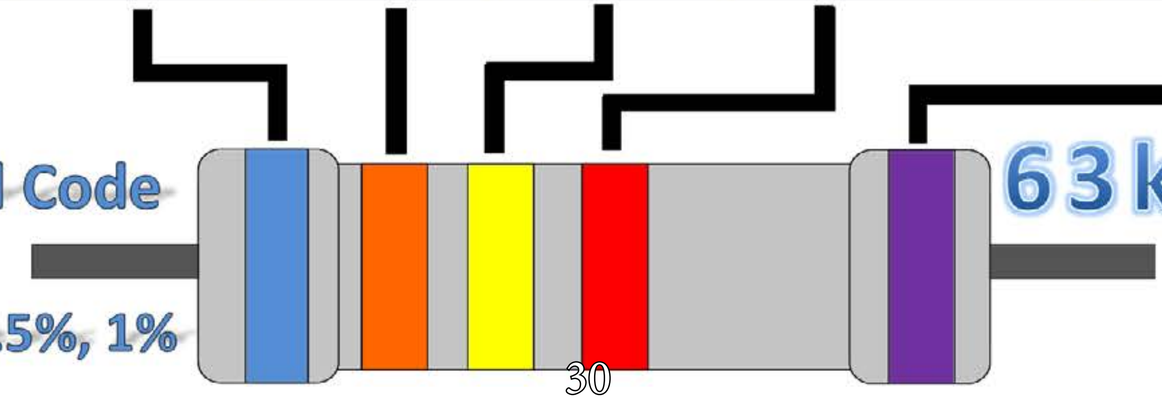


4k7Ω ±5%

Color	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1%
Red	2	2	2	100Ω	± 2%
Orange	3	3	3	1kΩ	
Yellow	4	4	4	10kΩ	
Green	5	5	5	100kΩ	± 0.5%
Blue	6	6	6	1MΩ	± 0.25%
Violet	7	7	7	10 MΩ	± 0.1%
Grey	8	8	8		± 0.05%
White	9	9	9		
Gold				0.1Ω	± 5%
Silver				0.01Ω	± 10%

5 – Band Code

0.1%, 0.25%, 0.5%, 1%

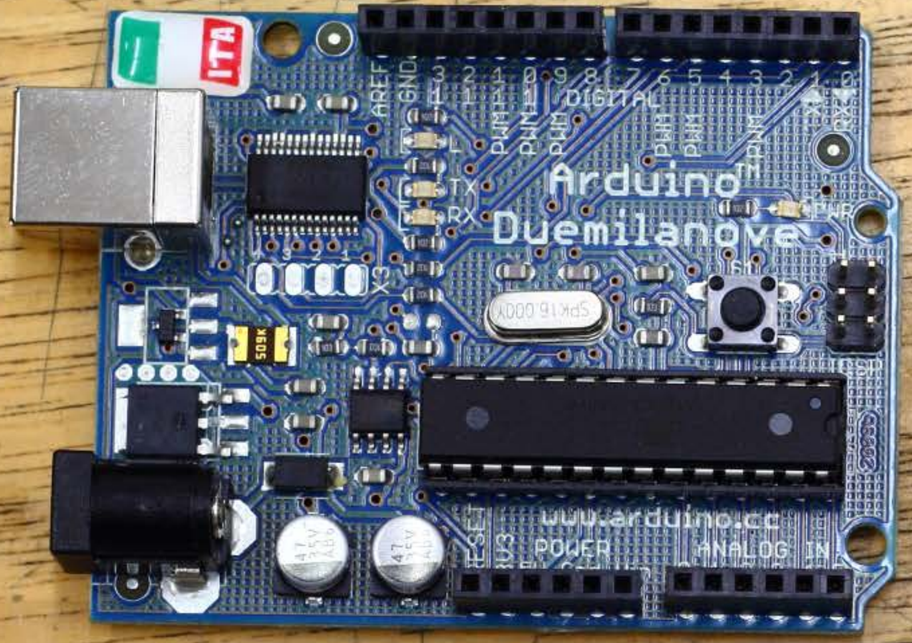


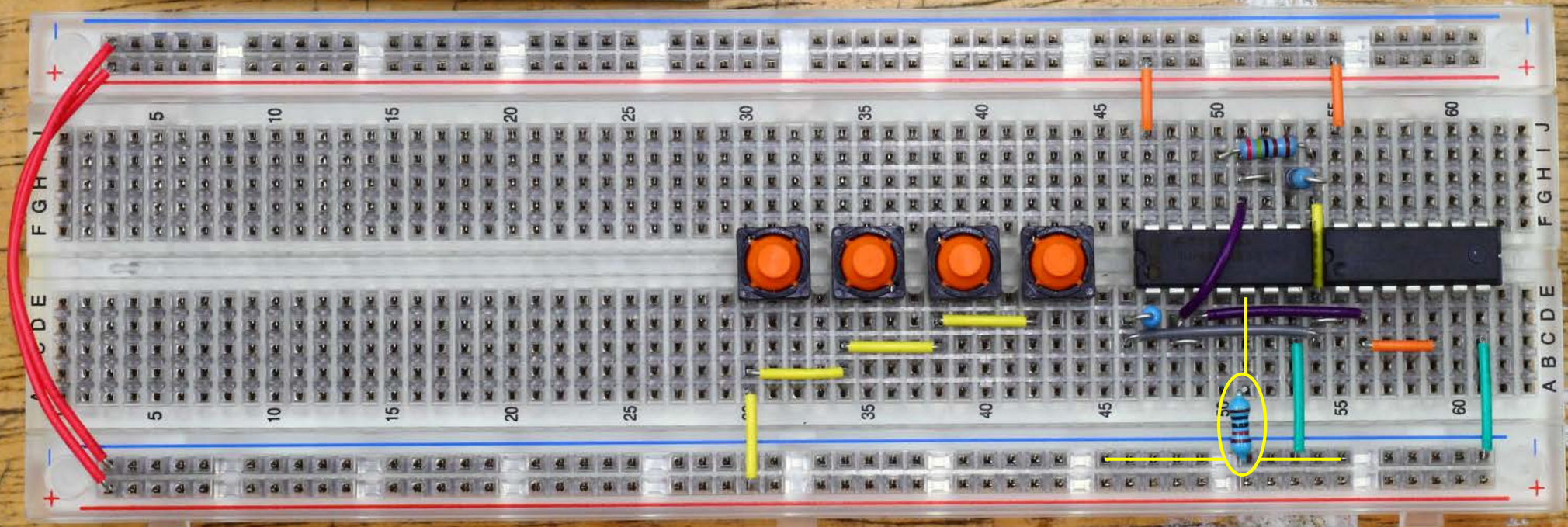
63k4 0.1%

Place the 2.4K resistor

Place the 5.1K resistor

Place the 20K resistor

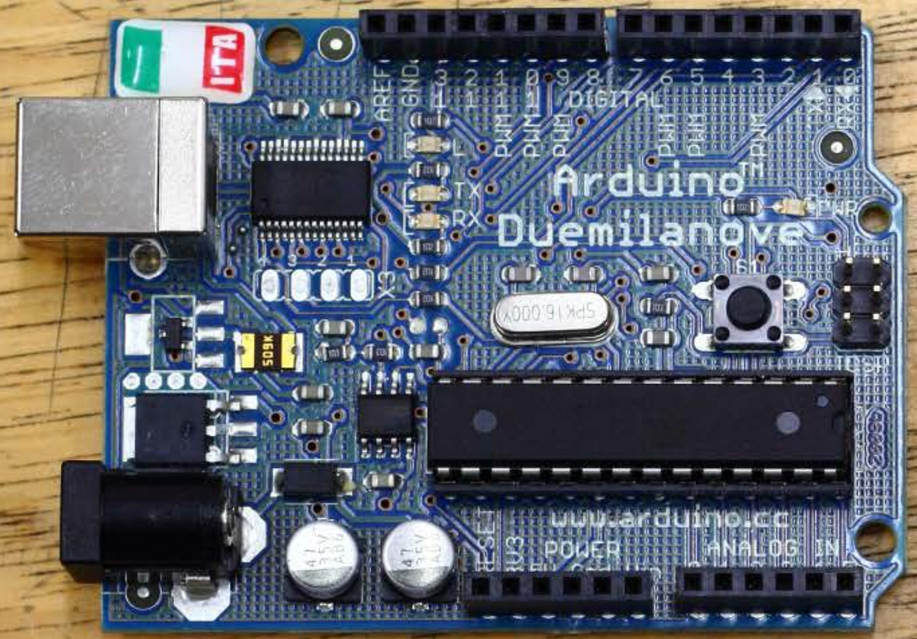


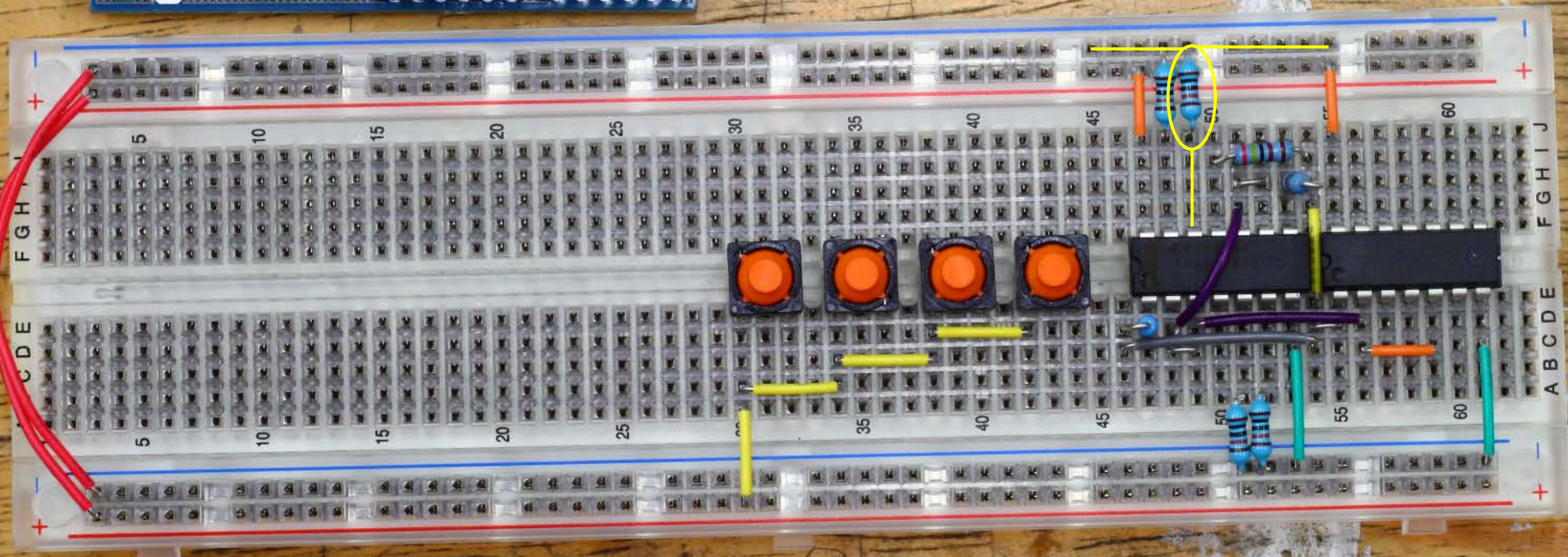


Place the 10K resistors

Place the 10K resistors

Place the 10K resistors





Place the 10K resistors

Place the last 10K resistor

Place the 1uF capacitor

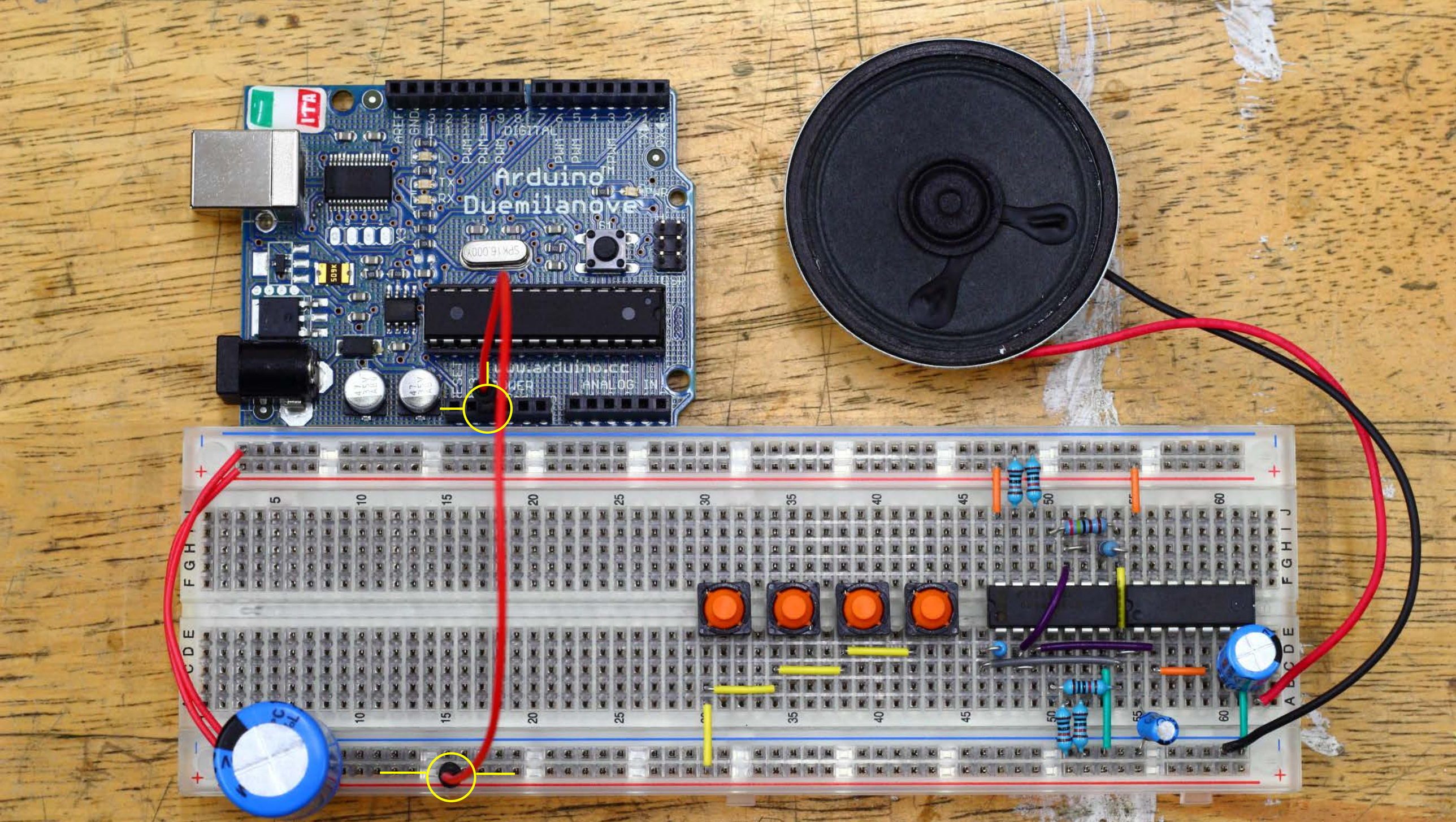
Take care to place the negative leg in the "-" rail

Place the 470uF capacitor

Place the Speaker

Place the 2200uF capacitor

Take care to match the polarity with the power rails



Connect the Arduino +5v to the + power rail on the breadboard

Connect the Arduino GND to the - power rail on the breadboard

Connect the buttons to the 4066

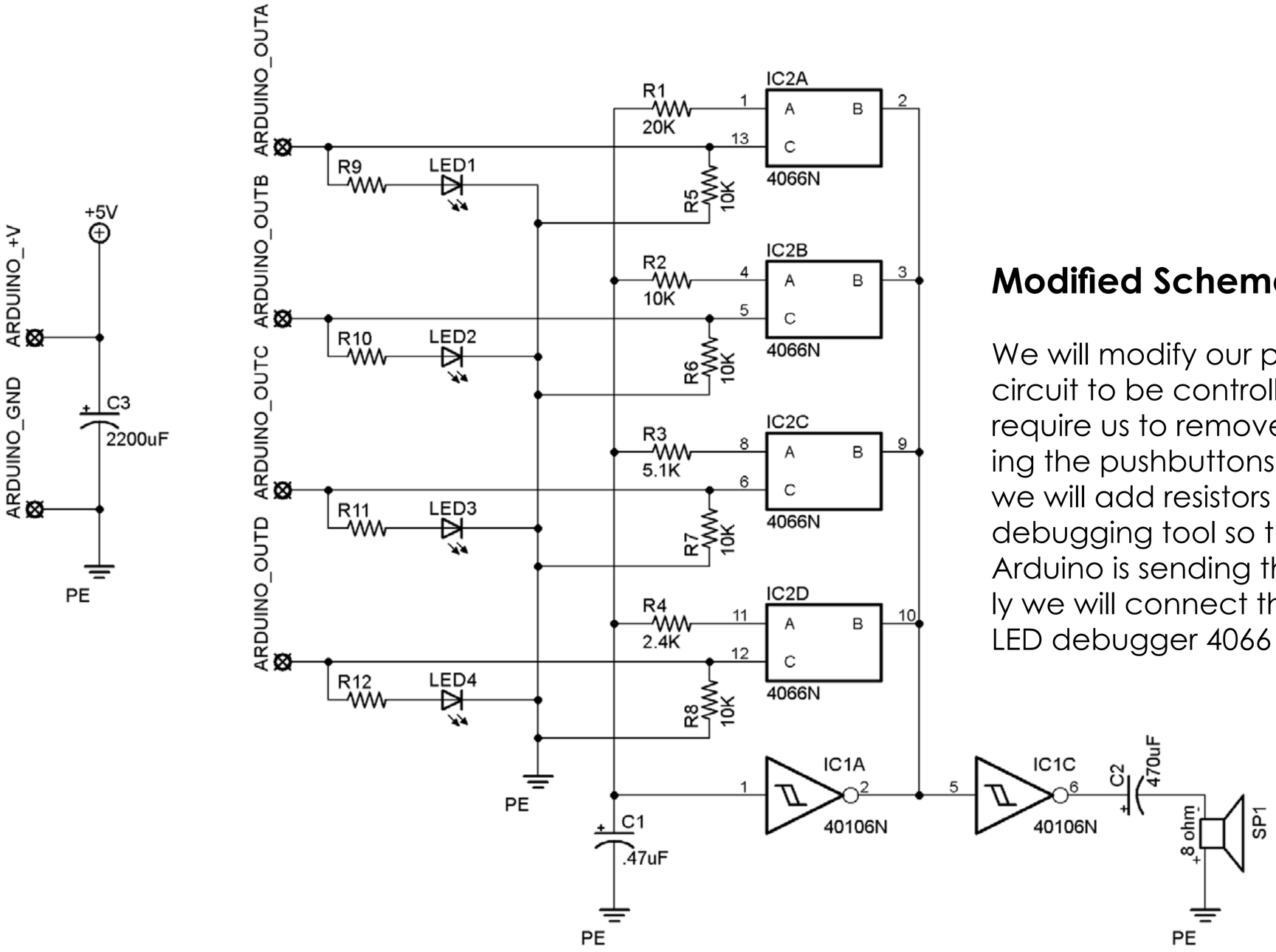
Connect the buttons to the 4066

Connect the buttons to the 4066

Connect the buttons to the 4066

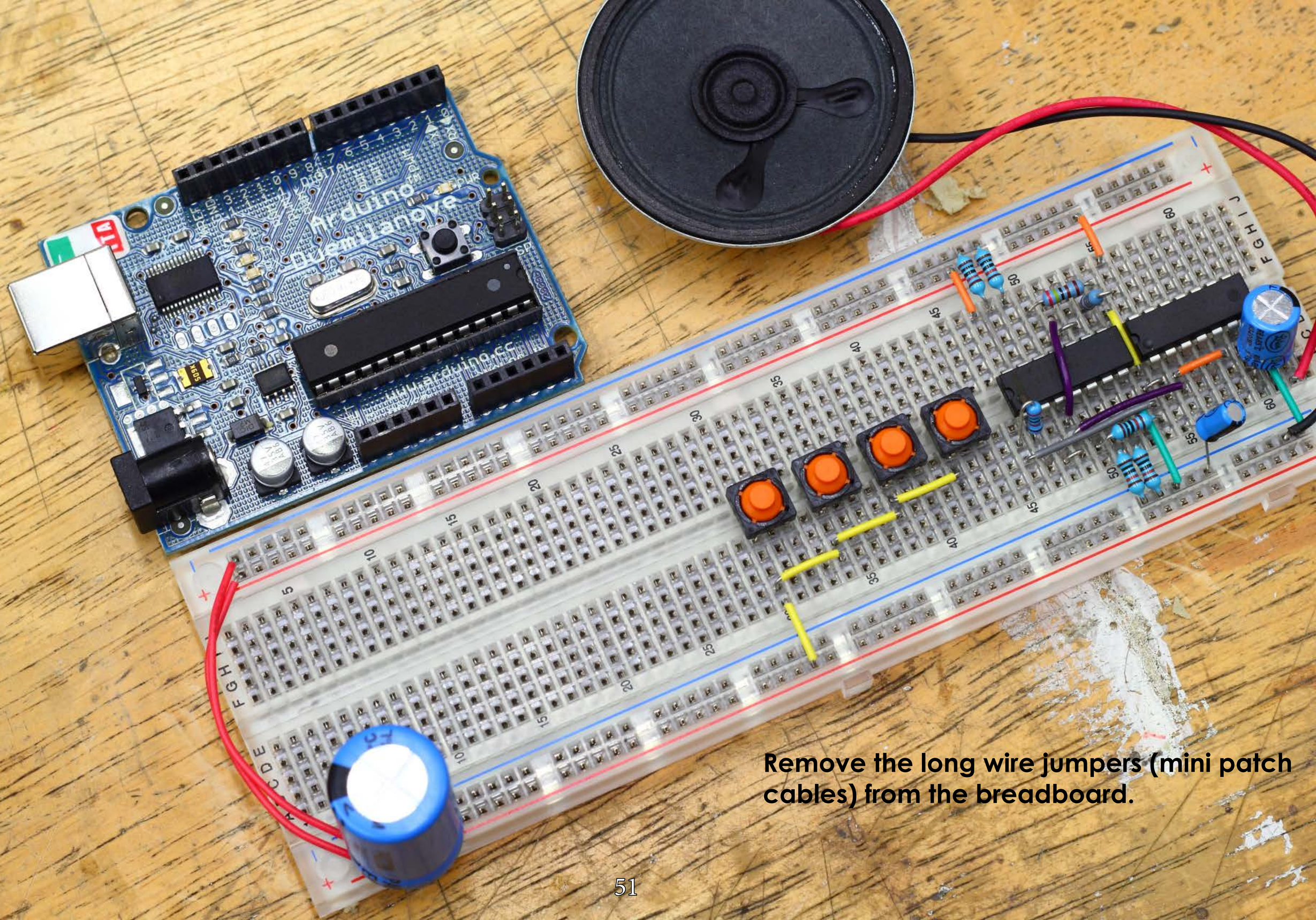
1. Connect Arduino to your computer via USB cable to provide power.

2. Mash the buttons!

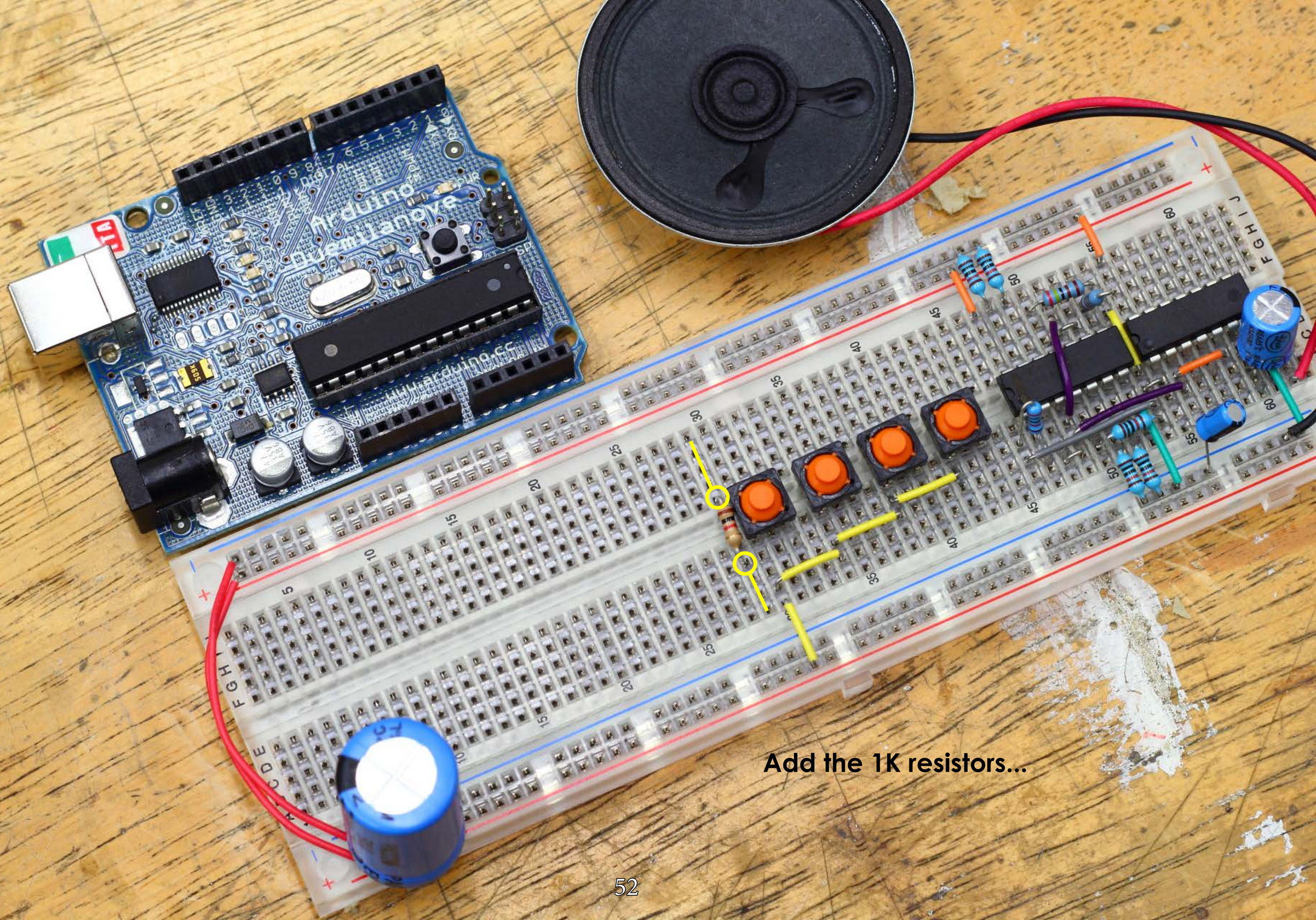


Modified Schematic for Arduino Control

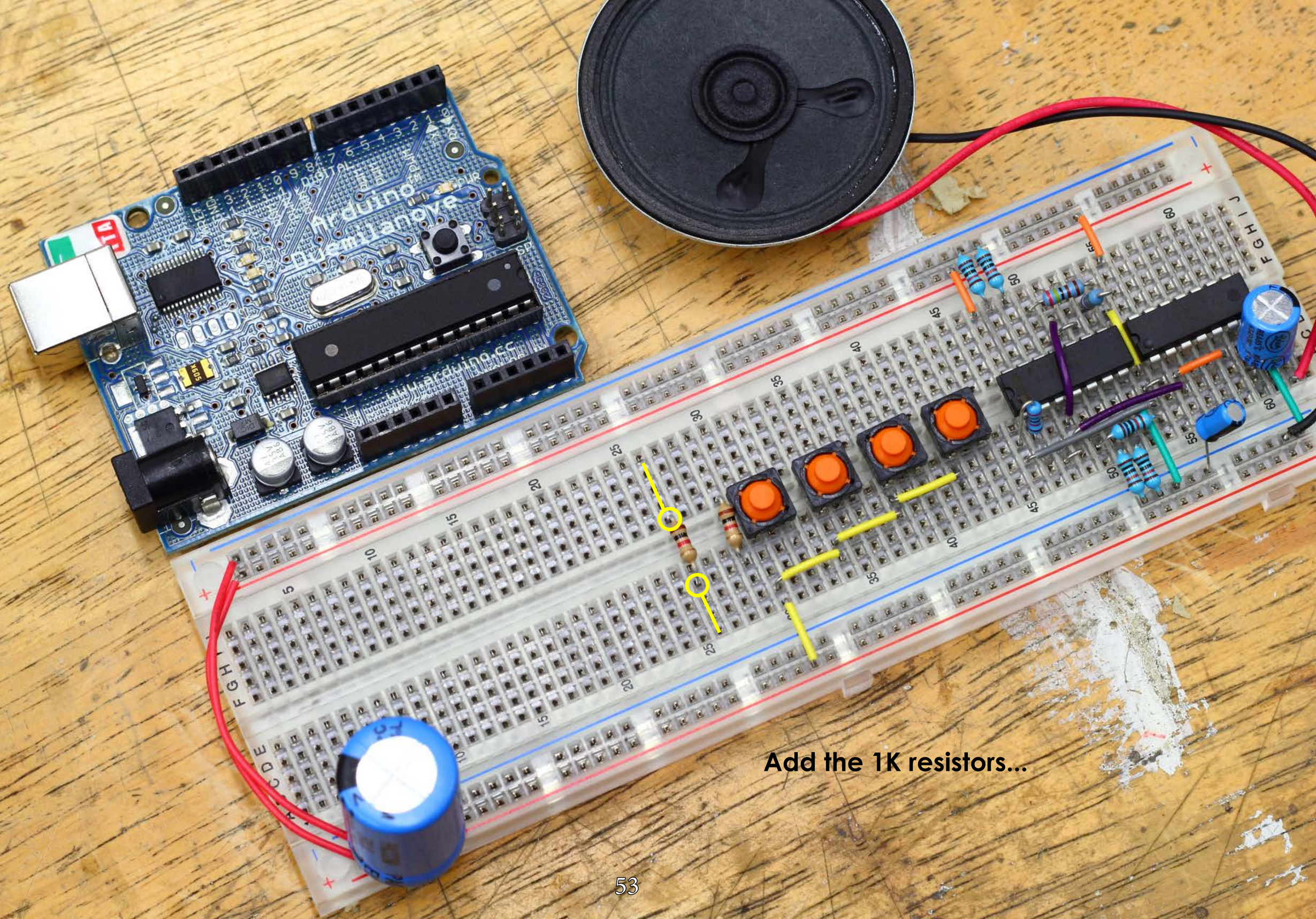
We will modify our push button controlled music circuit to be controlled via the Arduino. This will require us to remove the jumper wires connecting the pushbuttons to the 4066 control pins. Next we will add resistors and LEDs to give us a visual debugging tool so that we can see whether the Arduino is sending the right control signals. Finally we will connect the Arduino output pins to the LED debugger 4066 control input pins.



Remove the long wire jumpers (mini patch cables) from the breadboard.



Add the 1K resistors...



Add the 1K resistors...

Add the 1K resistors...

Add the last 1K resistor.

Add the LEDs...

NOTE: Be careful to place the short leg in the "-" voltage rail and the longer leg to the 1k resistor.

Add the LEDs...

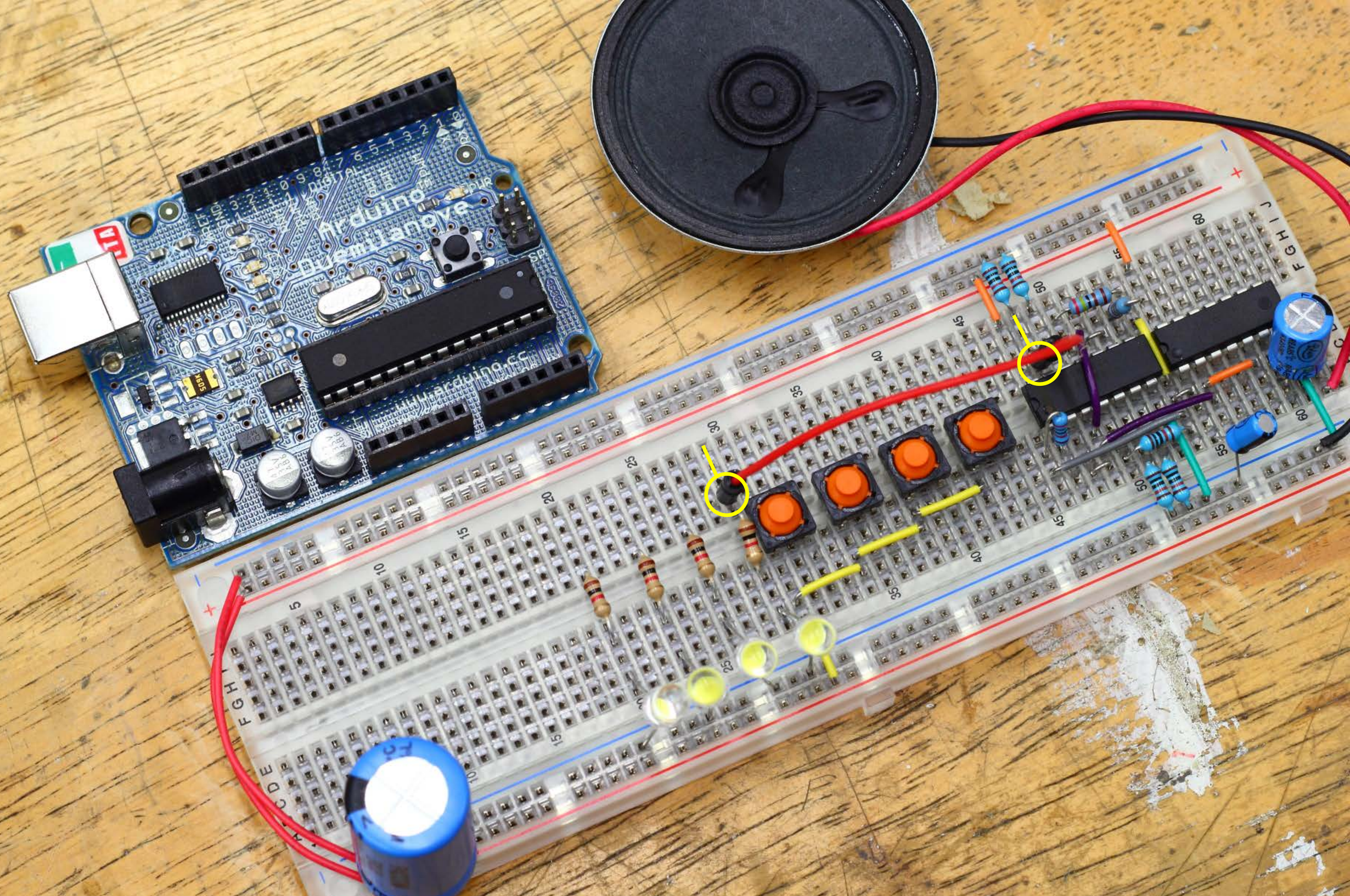
NOTE: Be careful to place the short leg in the "-" voltage rail and the longer leg to the 1k resistor.

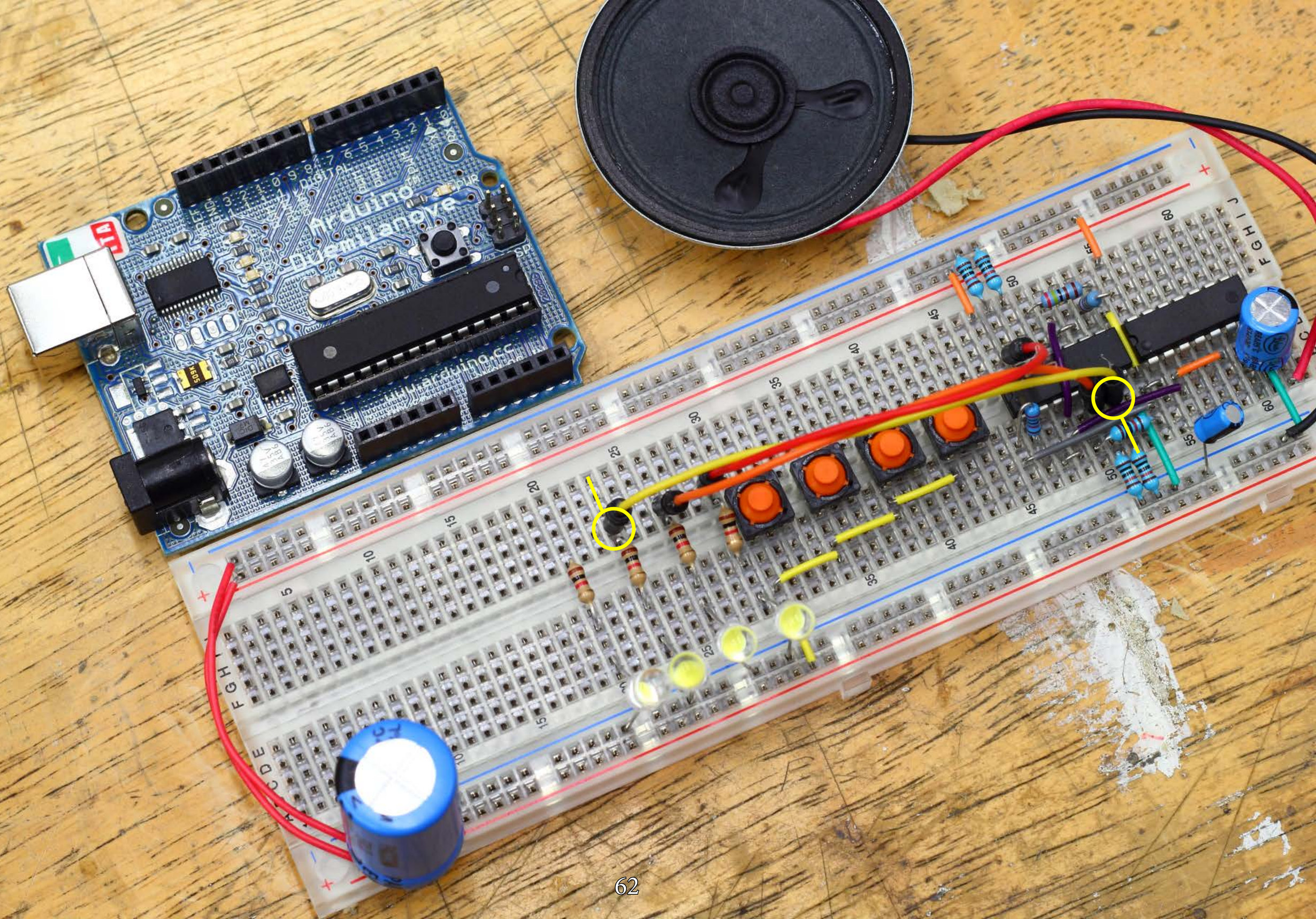
Add the LEDs...

NOTE: Be careful to place the short leg in the "-" voltage rail and the longer leg to the 1k resistor.

Add the last LED.

NOTE: Be careful to place the short leg in the "-" voltage rail and the longer leg to the 1k resistor.

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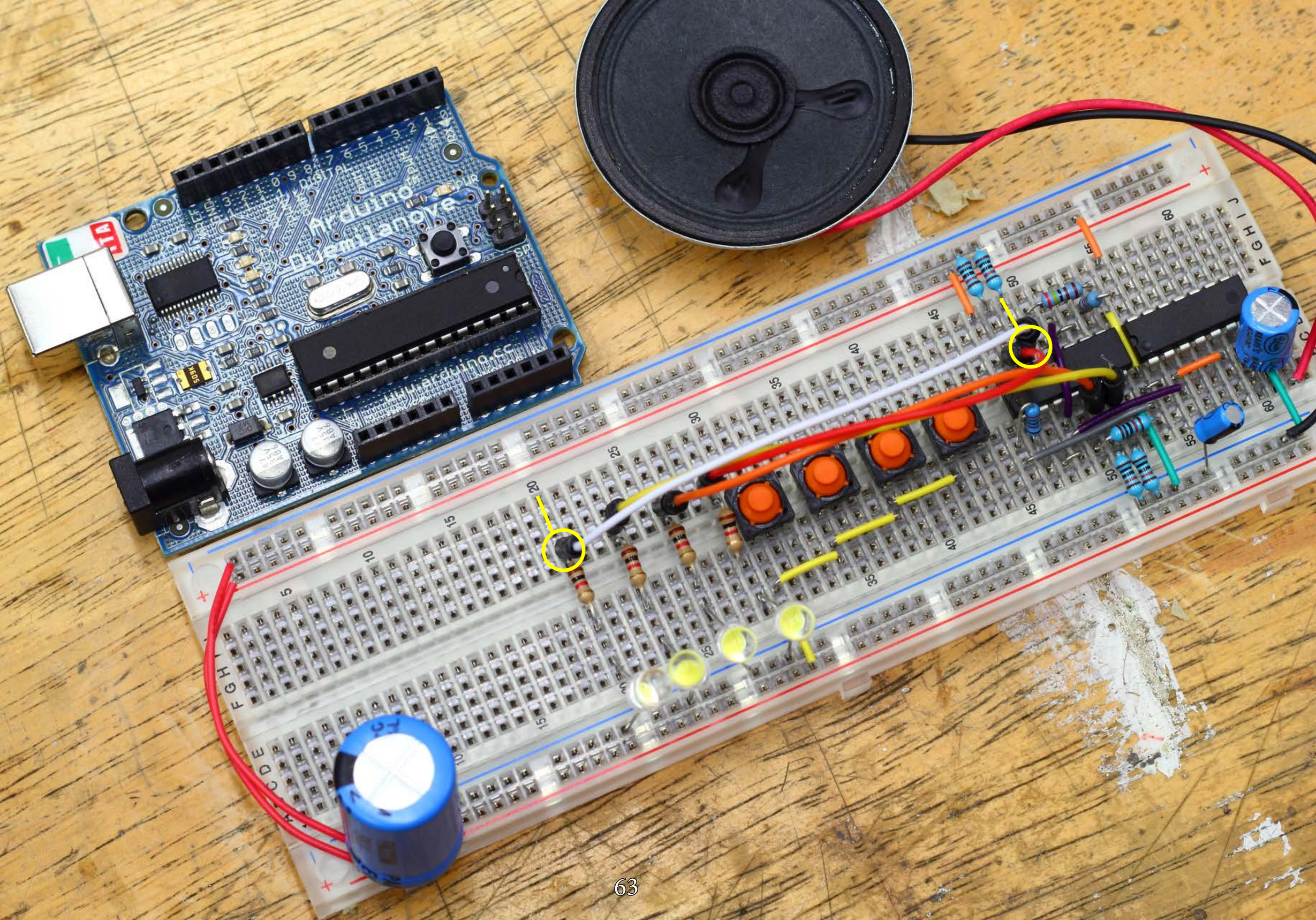
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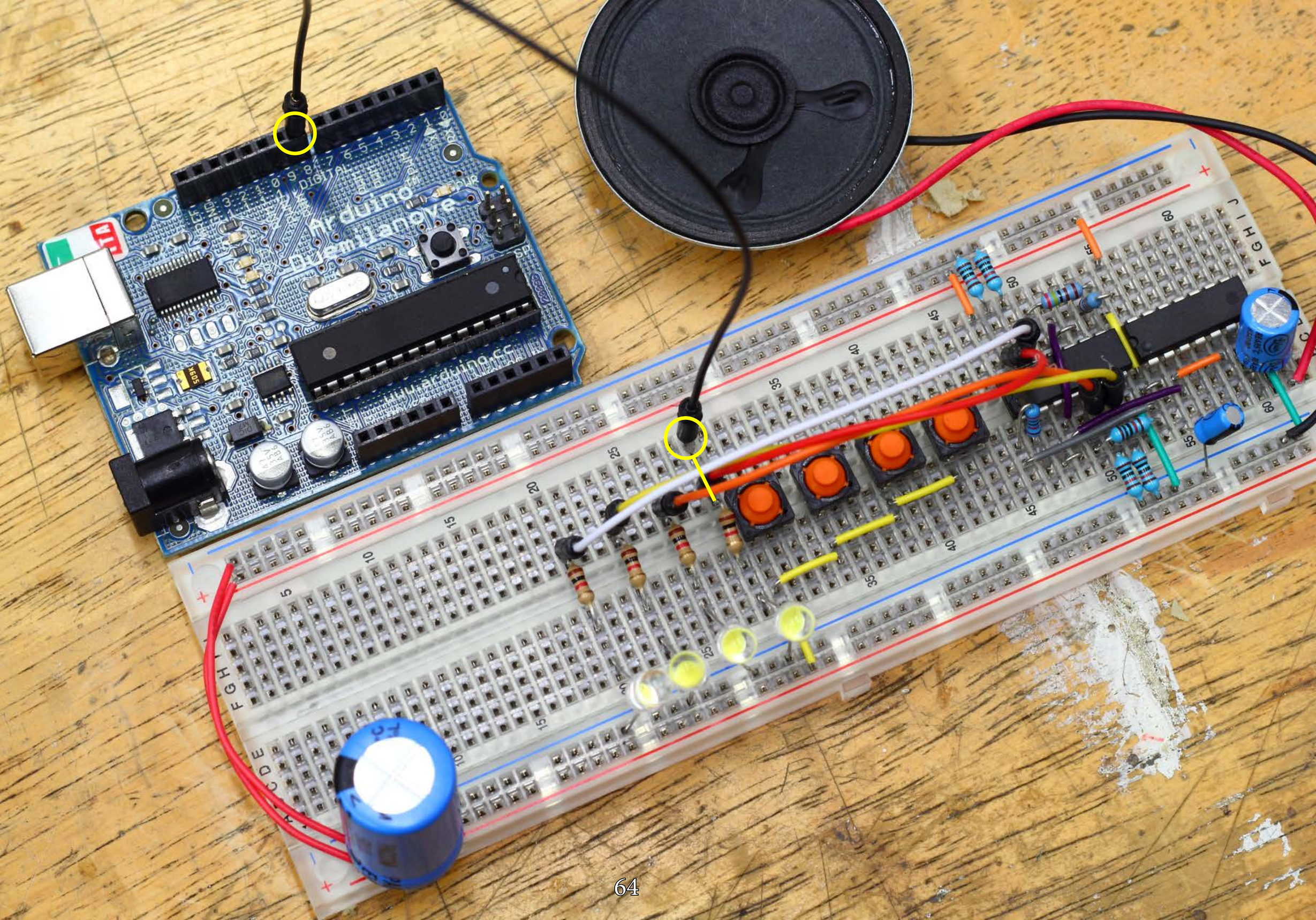
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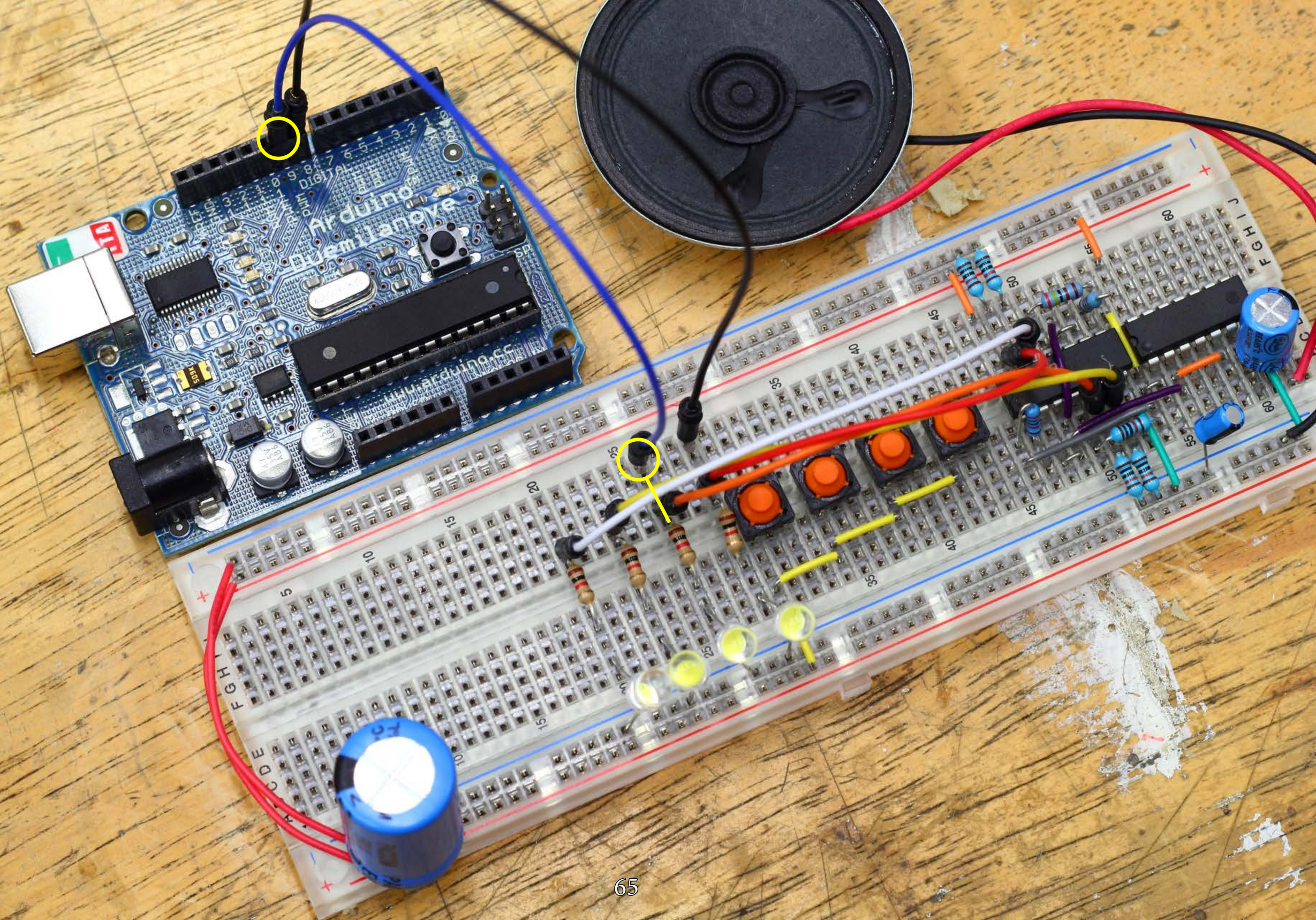
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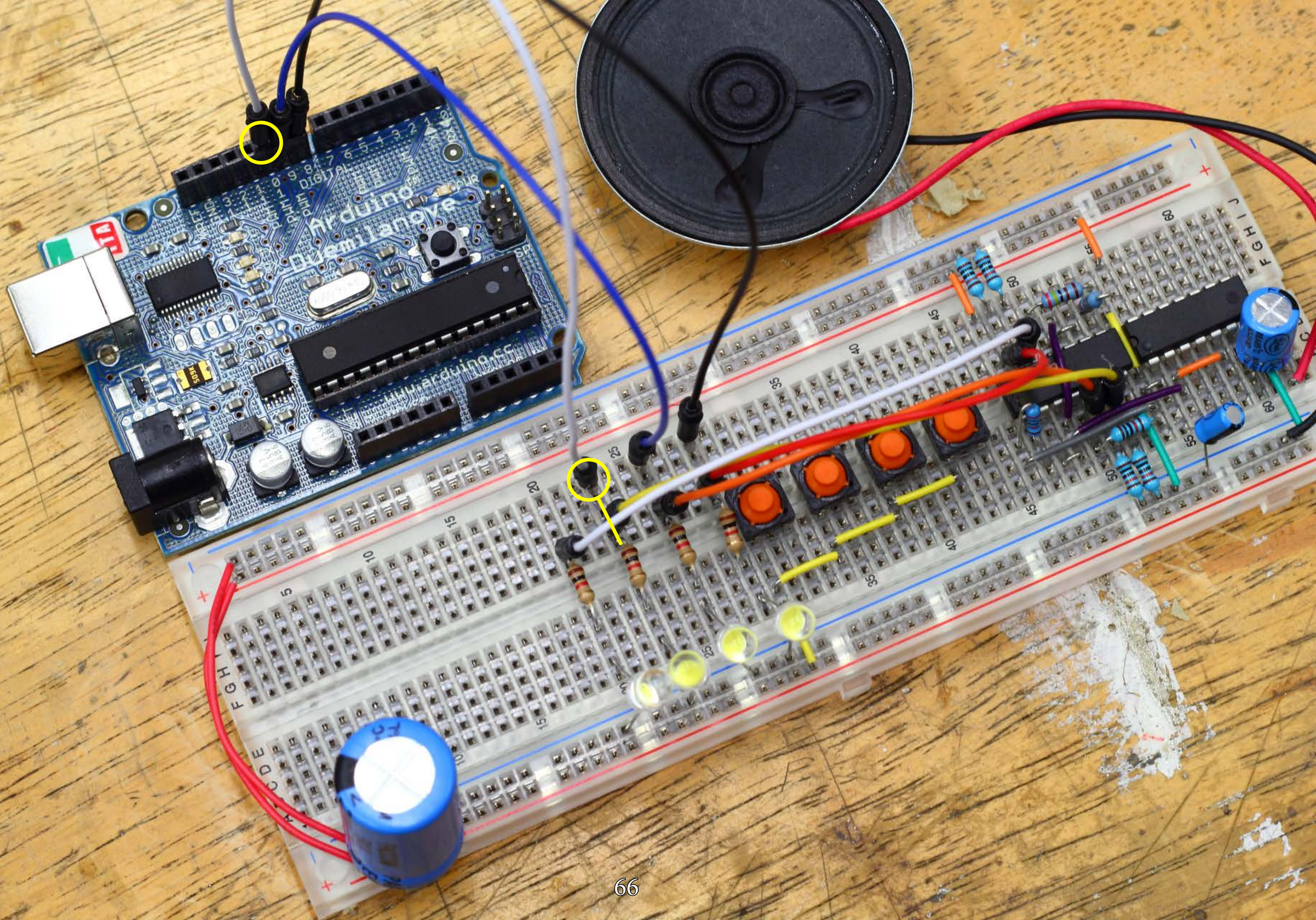
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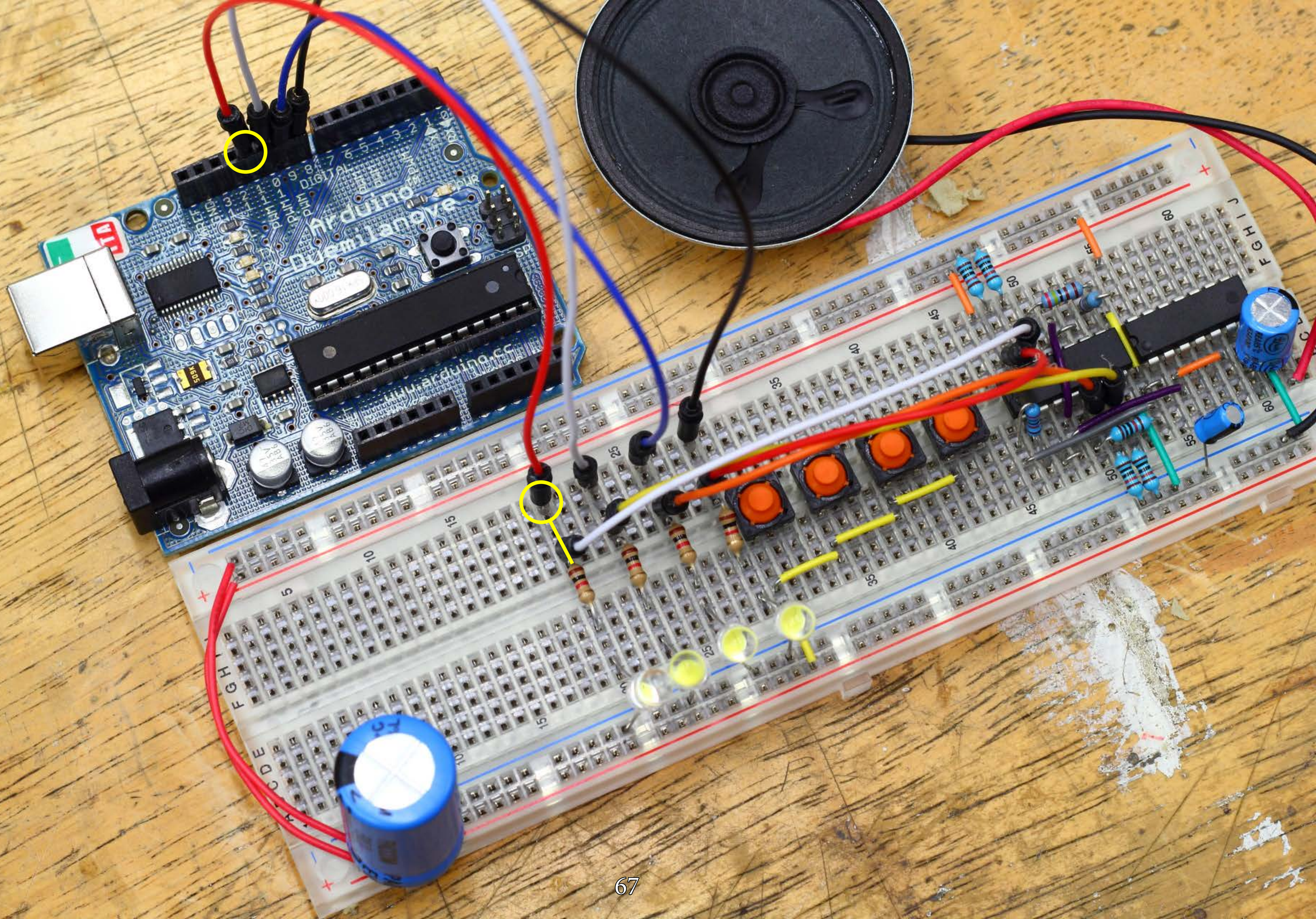
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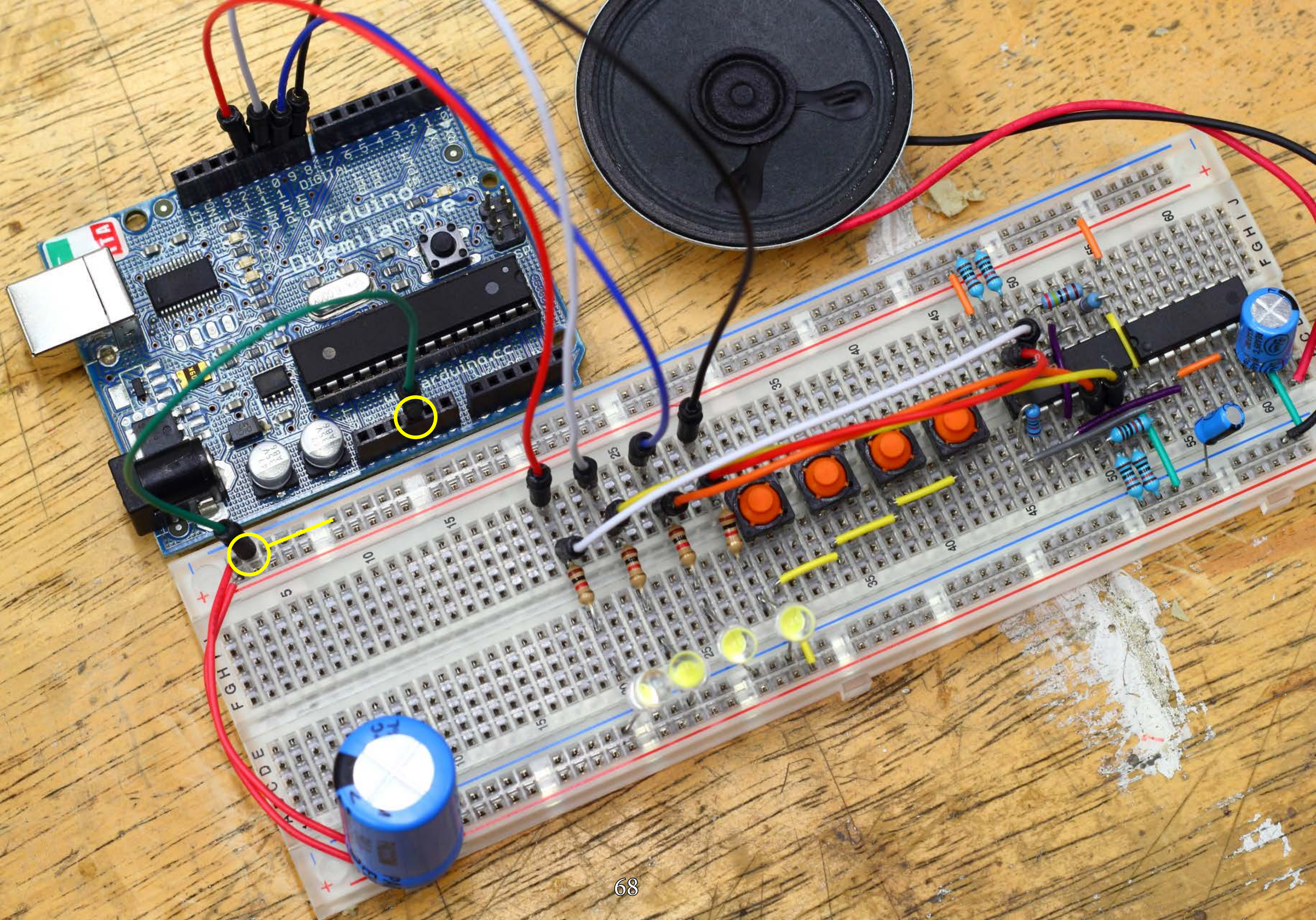
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Brasil
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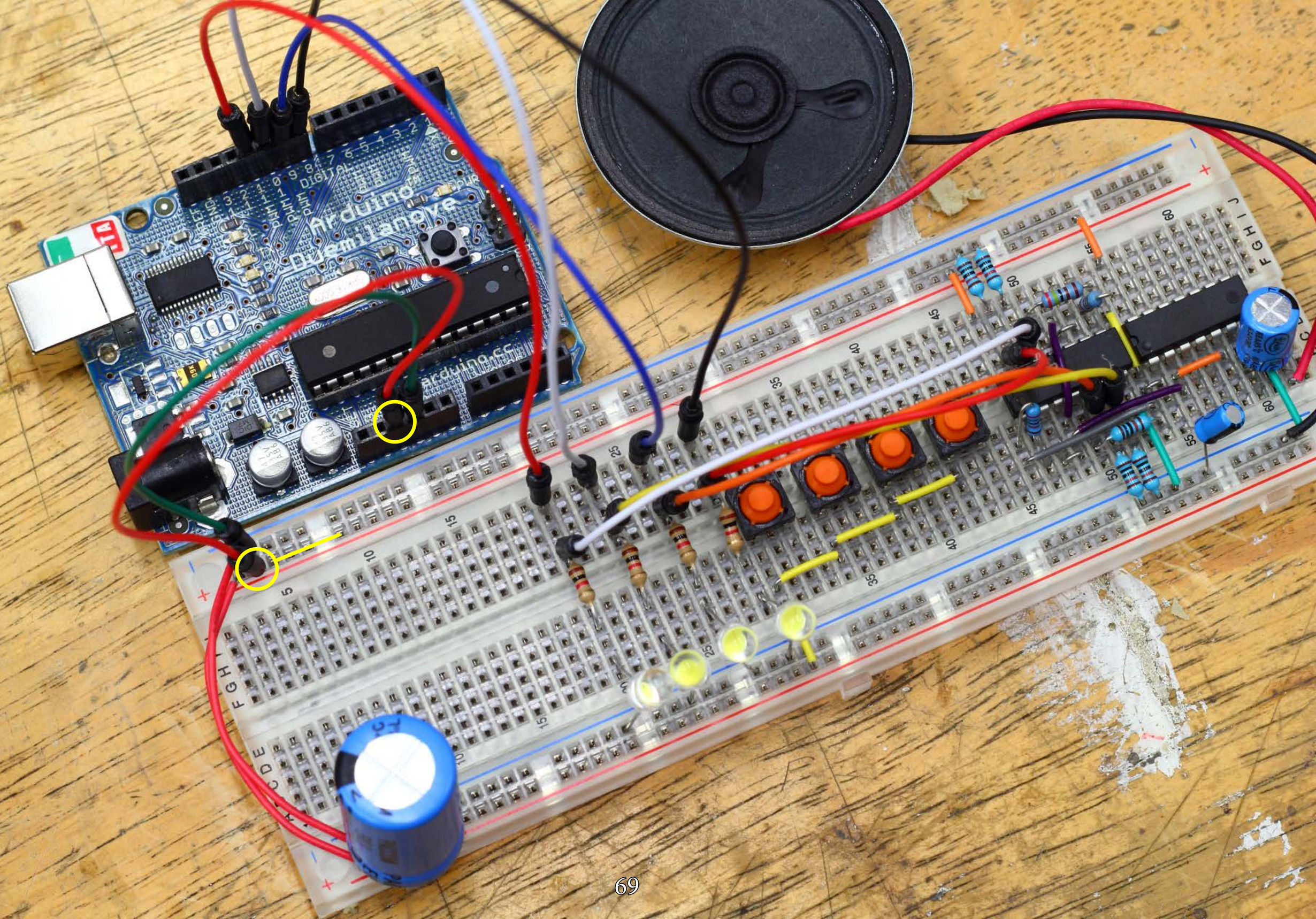
Arduino
DIGITAL
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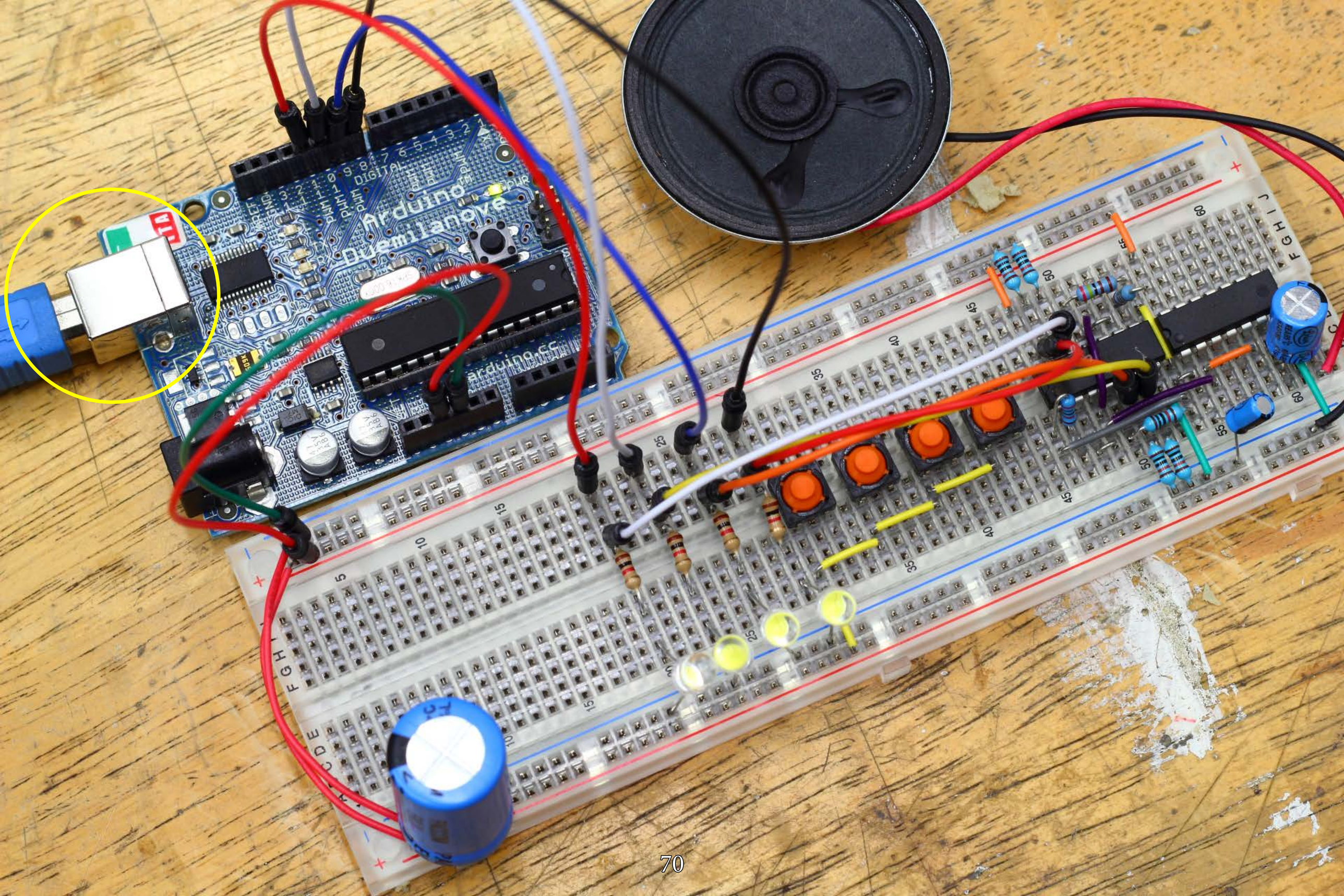
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