Show and Tell!
Output 1: Making Sound

Piezo buzzers
Piezo Buzzer
Piezo Buzzer

(a) Extended State

(b) Shrunked State

(c) A. C. Voltage Applied
Piezo Buzzer

(a) Extended State

(b) Shrunked State

(c) A.C. Voltage Applied

Diagram showing the internal components of a piezo buzzer, including plastic case, resonator, silicone adhesive, leads, piezoceramic plate, electrode (silver), adhesive, and brass plate.
Frequency (Hz) = \frac{1}{\text{Period (sec)}}

<table>
<thead>
<tr>
<th>note</th>
<th>frequency</th>
<th>period (microseconds)</th>
<th>PW (timeHigh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>261 Hz</td>
<td>3830</td>
<td>1915</td>
</tr>
<tr>
<td>d</td>
<td>294 Hz</td>
<td>3400</td>
<td>1700</td>
</tr>
<tr>
<td>e</td>
<td>329 Hz</td>
<td>3038</td>
<td>1519</td>
</tr>
<tr>
<td>f</td>
<td>349 Hz</td>
<td>2864</td>
<td>1432</td>
</tr>
<tr>
<td>g</td>
<td>392 Hz</td>
<td>2550</td>
<td>1275</td>
</tr>
<tr>
<td>a</td>
<td>440 Hz</td>
<td>2272</td>
<td>1136</td>
</tr>
<tr>
<td>b</td>
<td>493 Hz</td>
<td>2028</td>
<td></td>
</tr>
</tbody>
</table>
period

PW

period

PW
In Class Exercise

1. Connect your piezo buzzer
2. Play sound
3. Make a Theremin
4. Solder wires to a motor (for next Thursday)
1. Connect your piezo buzzer

Polarity matters!

black = ground
In Class Exercise

1. Connect your piezo buzzer
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3. Make a Theremin
4. Solder wires to a motor (for next Thursday)
2. Play Sound

Arduino

gnd

pin 7

```c
void loop() {
  digitalWrite(speakerPin, LOW);
  serByte = Serial.read();
  if (serByte != -1) {
    Serial.print(serByte, BYTE);
    ledState = !ledState; // flip the LED state
    digitalWrite(ledPin, ledState); // write to LED
  }
  for (count=0; count<8; count++) { // look for the note
    if (notes[count] == serByte) { // ooh, found it
      for (int i=0; i<50; i++) { // play it for 50 cycles
        digitalWrite(speakerPin, HIGH);
        delayMicroseconds(tones[count]);
        digitalWrite(speakerPin, LOW);
        delayMicroseconds(tones[count]);
      }
    }
  }
}
```

Serial message: ffffffff

Ready

fa fa fa fa fa fa fa fa fa fa fa

gaga gaga gaga gaga gaga gaga
2. Play Sound

If you want to make it quieter, add a resistor.
byte names[] = {'c', 'd', 'e', 'f', 'g', 'a', 'b', 'C'};
int tones[] = {1915, 1780, 1519, 1432, 1275, 1136, 1014, 956};
byte melody[] = "2d2a1f2c2d2a2d2c2f2d2a2c2d2a1f2c2d2a2a2g2p8p8p8p";
// count length: 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 10 20
In Class Exercise

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Theremin  (by Leon Theremin)

Measures the body’s electric field.
Your Theremin

```
void loop() {
  analogWrite(speakerPin, val); // adjust volume
  delayMicroseconds(val); // delay
}
```

```
for (int i=0; i<50; i++) { // play it 50 cycles
  digitalWrite(speakerPin, HIGH);
  delayMicroseconds(val);
  digitalWrite(speakerPin, LOW);
  delayMicroseconds(val);
}
```
In Class Exercise

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2. Play sound
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Let’s try to make beautiful music!
Homework

Input output coincidence exercise. Design an artifact where both input and output occur at the same place. Use any combination of your input transducers and output transducers (pot, photocell, FSR, LEDs, piezo, screen). E.g., a ball that changes colors and/or plays different sound/ melody depending on the pressure being applied. A stick you can twist to color or sound differently… These are just examples to spark your imagination. Be creative!
Announcement

Programming course by Patrick
Thursday, October 27, 2008 6:00PM in 110 South Hall
Thanks!