

# Pi-ano Stairs

By Rachel Arnold

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## Introduction

A Raspberry Pi is a computer that fits in the palm of your hand- besides being portable - the possibilities with code is endless. Today I would like to tell you about how with motion sensors, I was able to make a staircase make noises as you run up the stairs.

## The Idea

At the Museum of Science Boston, with the use of light reflection makes the stairs sound like a piano as you run up them. EPIC wanted to do something similar as advertisement, but my teacher and I worked together to make it our own.

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## How to make a Pi-ano Staircase yourself

### Supplies

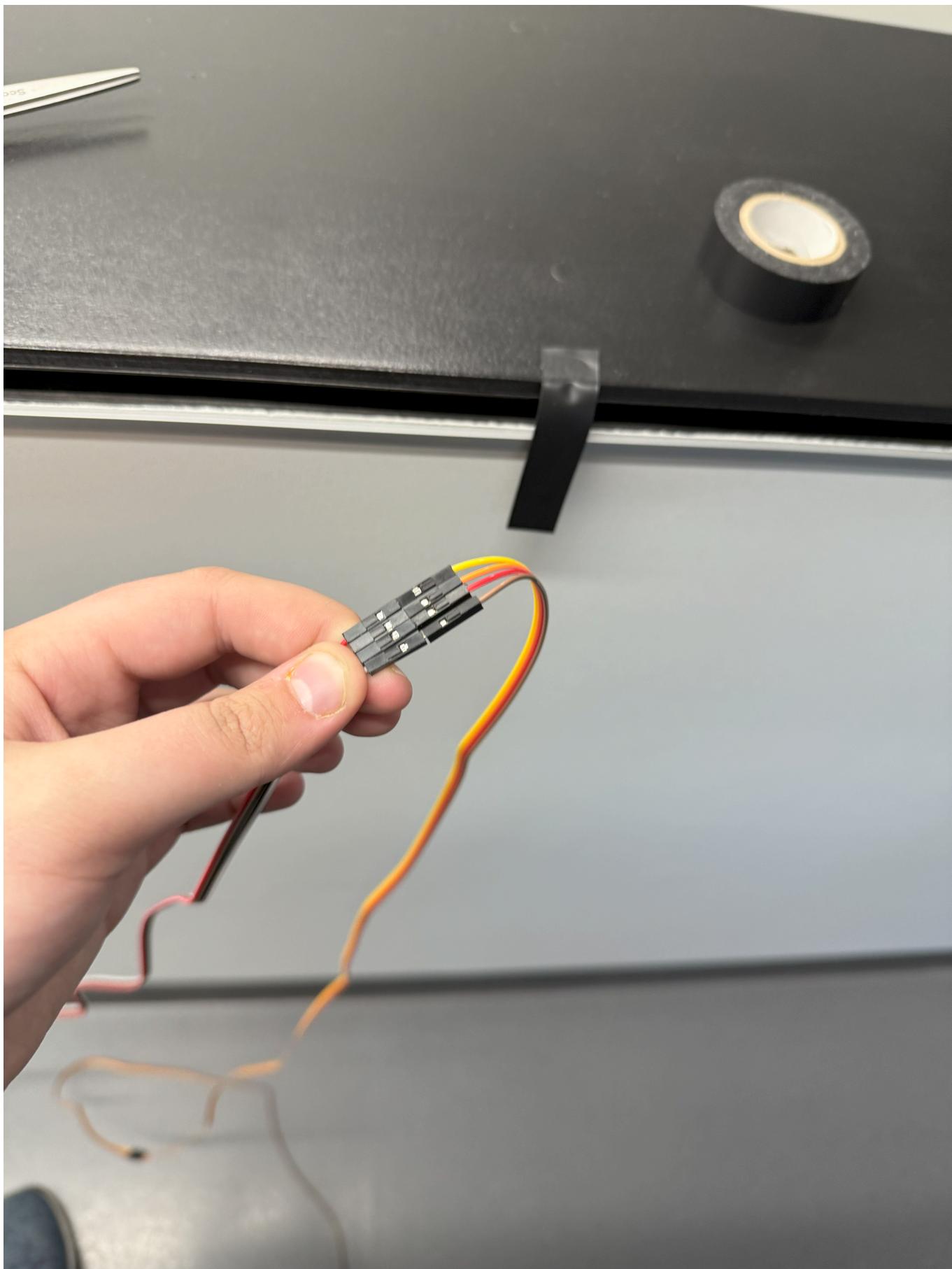
- Raspberry Pi
- Breadboard
- T-Cobbler and Ribbon Cable
- HC-SR04 Motion Sensors (Up to 8)
- Speaker
- Jumper Wires - M/F - At least 4 per sensor used
- Electrical Tape

### Step 1 - The Setup

Before powering on your PI, I recommend doing all of the wiring to prevent any shortages of your Pi or electrocuting yourself. Its important to note that I only set the Pi-ano up to four sensors but I coded the ability for as many as eight. Make sure to set the VCC on your sensor to a 5V pin on your breadboard, as well as setting the GND to a ground pin. Mixing these up will be very bad as it could result in not only breaking the sensor but even starting a fire!

- Sensor 1: `Trig` to GPIO 23, `Echo` to GPIO 24
- Sensor 2: `Trig` to GPIO 17, `Echo` to GPIO 27
- Sensor 3: `Trig` to GPIO 5, `Echo` to GPIO 6
- Sensor 4: `Trig` to GPIO 13, `Echo` to GPIO 19
- Sensor 5: `Trig` to GPIO 12, `Echo` to GPIO 16
- Sensor 6: `Trig` to GPIO 20, `Echo` to GPIO 21
- Sensor 7: `Trig` to GPIO 25, `Echo` to GPIO 8
- Sensor 8: `Trig` to GPIO 7, `Echo` to GPIO 1

Since I had my Pi-ano have motion sensors at the top and bottom of the staircase, I connected jumper wires to jumper wires. I used electrical tape to insure they stayed together. It is also very important to make sure you do not confuse the wires with each other when linking multiple cables. In the case this does happen be warned the sensor will become VERY HOT as it is frying itself internally. Make sure to unplug the sensor immediately! Also make sure to test all your sensors before taping all of them down, they could save you hours in the long run!



## | Wire Management

In order, to make this musical staircase practical, its important that you aren't tripping up the wires as you up up the stairs. This step is super easy, but the most time consuming. Using the edges of the walls, I used painters and electrical tape to secure the wires tightly. I wished it looked a little better but I was still able to make it look some what professional without getting anymore complicated. For a longer term project, you might consider wiring through the walls instead. But I was in a sticky situation, as I didn't have enough time to focus on it looking the most professional. Once all wires are taped down correctly, make sure to tape the motion sensor to the wall where it is aiming at the other wall, while crossing over the staircase. As long

as everything is taped down and wired correctly, the rest is easy!



## | Software Setup

Ensure you are in a virtual environment as soon as you begin to code. As well as doing the following commands in your terminal

To activate virtual environment:

```
source .venv/bin/activate
```

To play sound:

```
Pip install pydub
```

To control GPIO pins:

```
Pip install RPi.GPIO
```

Make sure to download MP3 files of any sounds you would like to play. On your PI add a folder where you will put the staircase script as well as any MP3 files you plan to use. Make sure to take note of the path to get to these files as you will need them for your code.

## I Coding

Finally now everything else is done, now comes the easy part. Find my code on a Git repository, make sure to change the CM distance as that should be different with each staircase. I did find that the motion sensors usually have a 40 CM range it will calculate. I printed the distances it calculated and ran it for about a minute, with this knowledge I adjusted my range until it would only play sound when a person triggered it. Once this is set up all you have left to do is create a Cron job so it will not always be on. For more specifics on Cron or

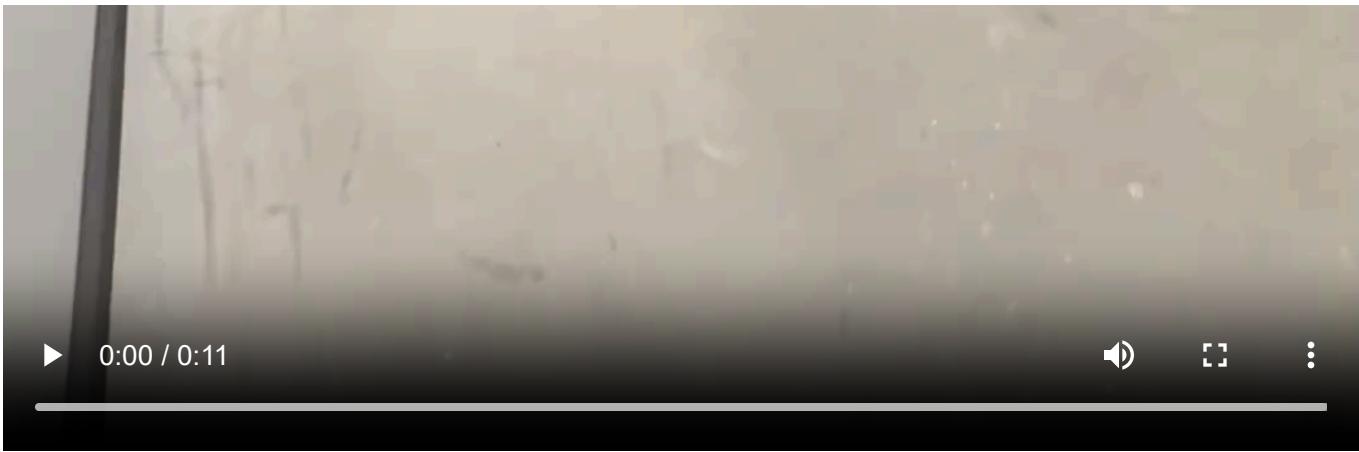
coding please refer to the links below.



## | Final Product

Here is a video showcasing the final Pi-ano.





## | Overview

Overall it was a success! This is a great project, as not only will you finish with a fun little gadget integrated into your everyday life but also you will leave it with a better understanding of python and the limits of jumper wires.



For any questions, you may email at

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Thank you for reading!

## | Useful Links

Motion Sensors

<https://howtomechatronics.com/tutorials/arduino/ultrasonic-sensor-hc-sr04/>

Cron

<https://ultahost.com/knowledge-base/setup-a-cron-job-in-linux/>

Boston Museum of Science Staircase

<https://www.bostonglobe.com/magazine/2012/09/15/the-famous-musical-stairs-boston-museum-science/6cZi9UJqrIpD0uNvKJVOBP/story.html>

Virtual Environments

<https://docs.python.org/3/library/venv.html>

See the Pi-ano yourself!

<https://littletonpublicschools.net/schools/epiccampus>

Everything

<https://chatgpt.com/>