Construct a Carnival Buzzer Game with a Raspberry Pi


Procedure PDF date: 2019-11-15

Experimental Procedure

Getting Started

In this project, you will make your own version of a classic carnival game, where you try to guide a metal loop along a bent metal wire without letting the two touch. If you have not already, you will need to set up your Raspberry Pi (http://www.sciencebuddies.org/science-fair-projects/project-ideas/CompSci_p056/computer-science/carnival-buzzer-game-raspberry-pi) before you begin. Watch this video for an introduction to the project:

https://www.youtube.com/watch?v=ENiahFX-p7E

Writing Your Program

If you have never written a program in Scratch before, watch this video to learn how:

https://www.youtube.com/watch?v=-X3XcWlw-lg

The objective of the game is to guide your paper clip "wand" down the bent wire, without letting the two touch, until you can tap the paper clip against the other paper clip at the bottom to win the game. If you touch the bent wire three times, you lose the game. So, you need a program that can do a few different things:

- Play a sound when the paper clip wand touches the wire
- Keep track of how many times the paper clip wand has touched the wire
- Play different sounds for winning and losing the game
- Automatically reset the game after you win or lose

The following program does just that. It consists of three if statements inside a forever loop. In addition to playing sounds, it also displays on-screen messages when you win or lose the game. This is a big program! Take your time and create a program based on the screenshot below, one block at a time. Remember to save your program frequently! You can also choose whatever sound effects you prefer from the Sounds tab.
If you get stuck, here are some helpful reminders for creating the program:

- The `set gpio __ to ____` and `gpio __ is high?` blocks are available under **More blocks**. If you do not see these blocks, click **Add an extension**, then click **PI GPIO** and select **OK**.
- To create a variable, click **Data** then **Make a variable**. Variables are convenient when you need to use a number multiple times in a program.
- The `==` block can be found under **Operators**. You use this block to check if two numbers are equal to each other.
- The `Say ____ for ____ secs` block can be found under **Looks**. This will make the on-screen sprite show a word bubble with text.
- The `join ____` block can be found under **Operators**. Use this to join together multiple strings of text, including variables.
- The `not ____` block can be found under **Operators**. Along with an if block, you can use this block to check if a certain condition is **not** true.

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**Learn More About:** How does the program work?  

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**Building Your Game**

To build the game, you will need some materials not included in your kit:

- Two **metal** paper clips. Make sure they are not coated in plastic.
- A small piece of cardboard
- Tape (any type of tape will work)

You will also need one of the piano wires from your kit (you can also substitute a sheet of aluminum foil rolled into a very tight tube):
First, take two paper clips. Straighten them out, then bend one end of each paper clip into a loop.

Next, bend one end of the piano wire into a "hook" shape, as shown below:

Then, tape the bent end of the piano wire down flat to a piece of cardboard. Make sure the tip of the piano wire is poking up out of the tape (you will need to attach an alligator clip to it later). Wrap a second piece of tape around the straight part at the bottom of the piano wire.
Loop one of the bent paper clips over the piano wire, and tape it down to the cardboard. Make sure there is tape in between the paper clip and the piano wire so they are not touching, or this will create a short circuit.

Finally, bend your piano wire into whatever shape you want. The more “bendy” you make the wire, the harder the game will be. If you would rather start out by leaving the wire straight, and bend it later, you can do that instead.
Here is an example where the piano wire has been replaced with a tightly rolled tube of aluminum foil:

![Figure 9](image)

**Building Your Circuit**

Next, you will need to build a circuit on a breadboard. If you have never used a breadboard before, watch this video to learn how:

[https://www.youtube.com/watch?v=6WReFkrULik](https://www.youtube.com/watch?v=6WReFkrULik)

To build the circuit, you will need three M-M jumper wires and three alligator clips:
Connect the jumper wires to the breadboard, as shown in Figure 12.
Then, connect alligator clips (with corresponding colors) to each of the jumper wires.

Finally, connect the other ends of the alligator clips to the parts of your game, as follows:

<table>
<thead>
<tr>
<th>Alligator Clip</th>
<th>Game Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Piano wire or aluminum foil</td>
</tr>
<tr>
<td>Yellow</td>
<td>Paper clip taped to cardboard</td>
</tr>
<tr>
<td>Black</td>
<td>Paper clip &quot;wand&quot;</td>
</tr>
</tbody>
</table>
Here is a picture of the complete setup:

Testing Your Game

Now you should be ready to test your game. Remember, the objective is to carefully guide the paper clip along the bendy wire without touching it, until you can reach the other paper clip at the bottom.
Click the green flag to start your program. After the "gong" sound plays, try the game! Challenge your friends and family to play as well. If you find the game to be too easy or too hard, there are a few different things you can adjust:

- To make the game easier:
  - Straighten out the piano wire.
  - Make the paper clip loop bigger.
  - Increase the delay1 variable.
  - Increase the number of times you can touch the wire before losing (change the number in the count = 3 block in your program).

- To make the game harder:
  - Put more bends in the piano wire.
  - Make the paper clip loop smaller.
  - Decrease the delay1 variable.
  - Decrease the number of times you can touch the wire before losing (change the number in the count = 3 block in your program).

Troubleshooting: My game does not work! [Show](#)

Going Further

There are a lot of fun things you can do to expand your game. Here are just a few suggestions:

- Add a single LED to your circuit that lights up briefly when you touch the piano wire.
- Add three LEDs to your circuit, like at the end of the demo video. Make one more LED light up and stay lit each time you touch the piano wire. Turn all the LEDs off again when the game resets. See the diagram below if you need help hooking up the LEDs, and refer to the Light-Up Piano [project](http://www.sciencebuddies.org/science-fair-projects/project_ideas/CompSci_p053/Computer-science/Electronics-Piano-Raspberry-Pi) if you need help with the Scratch code.
- Add a counter to the game by creating a variable that increases by 1 for every completion of the forever loop. Use this timer as a "score" for the player; the faster you complete the game, the better your score.
- Create a countdown timer that starts at a certain value and decreases by 1 for every completion of the forever loop. Make the player lose if time runs out. This will add some pressure to the game!
- For a big programming challenge, try to make a multi-player game. Let multiple players take turns trying the game, and keep score for each one (using one of the timer methods above, or based on who hits the wire the fewest times). Announce which player is the winner, based on who has the best score.
- For another challenge, make your program keep track of the "high score" (using one of the methods above). Display the current high score on screen, and update it if a player manages to beat the high score.

Here's a breadboard diagram of the circuit with three LEDs added (remember that the green, yellow, and black jumper wires on the left connect to the alligator clips):
Frequently Asked Questions (FAQ)

Kit General Questions

- Who is the kit appropriate for? [question2]
- Are the kit parts reusable? [question3]
- Aren’t there other Raspberry Pi kits on the market? How is yours different? [question5]
- I already have a Raspberry Pi. Can I just buy the circuit parts separately? [question-have]
- What programming language do the projects use? [question-lang]

Setting Up and Using Your Raspberry Pi FAQ

These answers apply to the Raspberry Pi Model 3B+ which comes with the Raspberry Pi Projects Kit. If you are using a different Raspberry Pi model you will need to do some research on your own—we suggest starting with the Raspberry Pi Foundation’s Setting up your Raspberry Pi page.

- How do I connect my Raspberry Pi to my TV or computer monitor? [question1]
- Can I use a laptop as a display and/or keyboard? [question4]
- How do I connect my Raspberry Pi to the internet? [question-how]
- How do I shut down or reboot my Raspberry Pi? There’s no power button! [question-reboot]
- How can I adjust the Raspberry Pi’s display resolution? [question-res]
- I have everything connected properly, why can’t I hear any sound? [question-sound]
- Why won’t my Raspberry Pi turn on? [question2]
- My Raspberry Pi starts to boot up, but then it freezes or the screen goes blank. What is wrong? [question-boot]
- My Raspberry Pi froze and is not responding to mouse or keyboard input. What should I do? [question12]
- My Raspberry Pi is acting strangely (it suddenly will not boot up properly, certain programs do not work, etcetera). What is wrong? [question13]
- I think I corrupted my Raspberry Pi’s SD card. What should I do? [question14]
- I need help with a question, related to my Science Buddies Raspberry Pi Projects Kit or Raspberry Pi Circuits Parts Only Kit, not listed here. Who can I ask? [question-last]

Kit General Answers
Q: Who is the kit appropriate for?
A: The kit is meant for anyone (ages 8 and up) who wants to learn some basic programming and electronics skills while having fun. Students up to age 10, or older if their reading skills are behind grade level, may need adult assistance in reading and following the on-screen instructions. The projects included in the kit were beta tested and approved by students ages 8 to 16.

Q: Are the kit parts reusable?
A: Yes, all the electronics components in the kit can be re-used to do new projects or to repeat the projects.

Q: Aren't there other Raspberry Pi kits on the market? How is yours different?
A: Yes, there are other Raspberry Pi kits, and some of them are quite good! The Raspberry Pi Projects Kit (http://www.sciencebuddies.org/store-send/7u/) and Raspberry Pi Circuit Parts Only Kit (http://www.sciencebuddies.org/store-send/7u/) have been designed to contain the specific materials needed to do the accompanying Science Buddies Raspberry Pi projects. Our kit and associated projects are specifically meant for people who have no prior experience programming or connecting circuits. The projects are 100% beginner friendly with clear on-screen instructions, pictures, and videos. We think the kit, with its associated projects, is one of the most fun kits out there! But, if you are already an ace programmer or electronics guru, you may not find this the best fit for your own personal use. Even so, it may be a fun way for you to introduce others to programming and electronics.

Q: I already have a Raspberry Pi. Can I just buy the circuit parts separately?
A: Yes! We sell two different kits: the Raspberry Pi Projects Kit (http://www.sciencebuddies.org/store-send/7u/) which includes a Raspberry Pi and the required accessories, and the Raspberry Pi Circuit Parts Only Kit (http://www.sciencebuddies.org/store-send/7u/), which only contains the additional circuit parts you need to do the Science Buddies projects. Both kits contain an SD card with the Raspbian operating system and a desktop shortcut to the Science Buddies project instructions.

Q: What programming language do the projects use?
A: The projects use Scratch 2. Scratch is a “graphical” programming language developed by the MIT Media Lab. It allows you to write code by clicking, dragging, and snapping together color-coded blocks. This allows beginners to write working code without worrying about formatting or typos. On the Raspberry Pi, Scratch allows you to control the general purpose input and output (GPIO) pins so your program can interact with a circuit in the physical world.

Note: three different versions of Scratch (1, 2, and 3) are available for the Raspberry Pi. The instructions for the Science Buddies projects (including example code) are specifically written for Scratch 2, which runs well on the Raspberry Pi model 3B+. If you have an older model Raspberry Pi, Scratch 2 may run more slowly, or may not run at all. If you want to use a different version of Scratch, you will need to consult the official documentation for Scratch 1.4 (https://www.raspberrypi.org/documentation/usage/scratch/14_README.txt) or Scratch 3 (https://www.raspberrypi.org/blog/scratch-3-desktop-for-raspbian-on-raspberry-pi/) and modify the programming steps accordingly.

Setting Up and Using Your Raspberry Pi FAQ Answers

Q: How do I connect my Raspberry Pi to my TV or computer monitor?
A: The easiest way to set up your Raspberry Pi is to use an HDMI cable (included in the Science Buddies Raspberry Pi Projects Kit (http://www.sciencebuddies.org/store-send/7u/)) to connect to a TV or computer monitor that has built-in speakers. If you are using a computer monitor with an HDMI port but no built-in speakers, you will also need separate speakers or headphones with a 3.5 mm audio plug (a regular “headphone jack”).

If your TV or monitor does not have an HDMI port, you will need an HDMI to DVI or HDMI to VGA adapter (see pictures in table below). DVI and VGA do not transmit sound, so you will need separate headphones or speakers if you are using one of those options.

<table>
<thead>
<tr>
<th>HDMI</th>
<th>DVI</th>
<th>VGA</th>
</tr>
</thead>
</table>

Q: Can I use a laptop as a display and/or keyboard?
A: The short answer is “not easily.” Many newer laptops have HDMI ports, but they only function as HDMI out, to send a video signal from the laptop to a television or projector. They do not work as HDMI in to display an external signal on the laptop’s screen. The laptop’s keyboard is only designed to work with the laptop itself, not as a standalone keyboard for an external device like the Raspberry Pi.

The longer answer is that, similar to the Remote Desktop feature on Windows and Mac computers, you can use special software to remotely operate a Raspberry Pi that is connected to the internet. This would allow you to control a Raspberry Pi using your laptop’s screen and keyboard. This option is only recommended for advanced users, and you can find instructions here (https://www.raspberrypi.org/documentation/remote-access/remote-desktop/).

Q: How do I connect my Raspberry Pi to the Internet?
A: Unlike earlier models, the Raspberry Pi 3B+ contains built-in Wi-Fi functionality. It does not require an external USB Wi-Fi adapter. You can connect your Raspberry Pi to the internet by clicking the internet icon in the taskbar and searching for available Wi-Fi networks, just like you would on a Windows or Mac computer. Your Raspberry Pi also has an ethernet port, which you can use to plug directly into a router for a hardwired connection.

Q: How do I shut down or reboot my Raspberry Pi? There’s no power button!
A: Unlike most computers, the Raspberry Pi does not have a power button. You can shut down or reboot by clicking the raspberry icon in the upper left corner of your desktop, then select Shutdown. After the Raspberry Pi has shut down, it is safe to unplug the micro-USB power cable. Plug the cable back in to reboot. **Important:** never unplug the power cable while the Raspberry Pi is still running. This can corrupt the SD card.

Q: How can I adjust the Raspberry Pi's display resolution?
A: Click the Raspberry Pi logo in the top-left corner of your desktop. Select Preferences, then Raspberry Pi Configuration, then click the Set Resolution... button on the System tab.

Q: I have everything connected properly. Why can't I hear any sound?
A: Right-click the speaker icon on the desktop taskbar. This allows you to manually select HDMI or analog (the headphone jack) for sound output. Make sure you have the proper output selected. Also, make sure your Scratch program is set to play a sound. You can write a simple program to test if your sound is working using the “when space key pressed” and “play sound meow” blocks.

Q: Why won't my Raspberry Pi turn on?
A: If your Raspberry Pi will not turn on (the screen remains blank after everything is plugged in), go through this checklist to make sure everything is set up properly.

1. Make sure your SD card is pushed in all the way (see Figure 1).
2. Make sure the red power LED on your Raspberry Pi (labeled “PWR,” near the micro-USB port, see Figure 2) is on. This means the Raspberry Pi is receiving power from the micro-USB port. If the LED is not on, make sure you pushed the micro-USB connector into the micro-USB port all the way.
3. When you first plug the micro-USB cable in, the green LED (labeled “ACT,” next to the PWR LED, see Figure 2) should flash several times. This LED flashes when the Raspberry Pi reads data from the SD card. After the Raspberry Pi is done booting up, it should turn off. If it does not flash at all, your SD card might not be inserted properly. Go back to step 1.
4. Make sure your display (television or monitor) is turned on. If your display is turned off, you will not see anything on the screen, even if the Raspberry Pi is on.
5. Make sure your display is set to the correct input. Many modern TVs have more than one HDMI input, and some computer monitors have DVI or VGA inputs in addition to HDMI.

Figure 1. A micro-SD card that is inserted properly (left) and one that is not pushed in all the way (right).
Q: My Raspberry Pi starts to boot up, but then it freezes or the screen goes blank. What is wrong?
A: There may be a problem with your Raspberry Pi or SD card. If you are using the Raspberry Pi or SD card that came with the Raspberry Pi Projects Kit or Raspberry Pi Circuit Parts Only Kit purchased from our partner Home Science Tools, please contact them directly at service@homesciencetools.com for assistance.

Q: My Raspberry Pi froze and is not responding to mouse or keyboard input. What should I do?
A: First, be patient and give the Raspberry Pi a few minutes to try and process whatever it was doing. If you click on a whole bunch of things in rapid succession, or run a really complicated Scratch program, the Raspberry Pi might slow down or freeze temporarily.

Next, if you are using a wireless keyboard and mouse, make sure they have fresh batteries.

Finally, as a last resort, if your Raspberry Pi is not responding, unplug the micro-USB cable and plug it back in. In general, you want to avoid doing this, because suddenly cutting power to the Raspberry Pi without properly shutting it down first can corrupt the SD card, and prevent the Raspberry Pi from working properly.

Q: My Raspberry Pi is acting strangely (e.g. it suddenly will not boot up properly, certain programs do not work, etc.). What is wrong?
A: If your Raspberry Pi is not "dead," but seems to be behaving strangely, there is a chance that your SD card has become corrupted. This can happen if you unplug the Raspberry Pi's power cord without properly shutting it down first. See the next question.

Q: I think I corrupted my Raspberry Pi's SD card. What should I do?
A: If the SD card came with the Raspberry Pi Projects Kit or Raspberry Pi Circuit Parts Only Kit you purchased from our partner Home Science Tools, please contact them directly at service@homesciencetools.com for assistance. Make sure to include a detailed description of the problem you are having. They will work with you to resolve the issue.

Q: I need help with a question, related to my Science Buddies Raspberry Pi Projects Kit or Raspberry Pi Circuits Parts Only Kit, not listed here. Who can I ask?
A: Science Buddies has a special area of our Ask an Expert forums dedicated to the Raspberry Pi Projects Kit. Please note that the forums are staffed by volunteers, and it may take a few days to get a response. If you are doing a science project, please do not wait until the day before the project is due to ask an urgent question.