Arduino Magnetic Pet Door

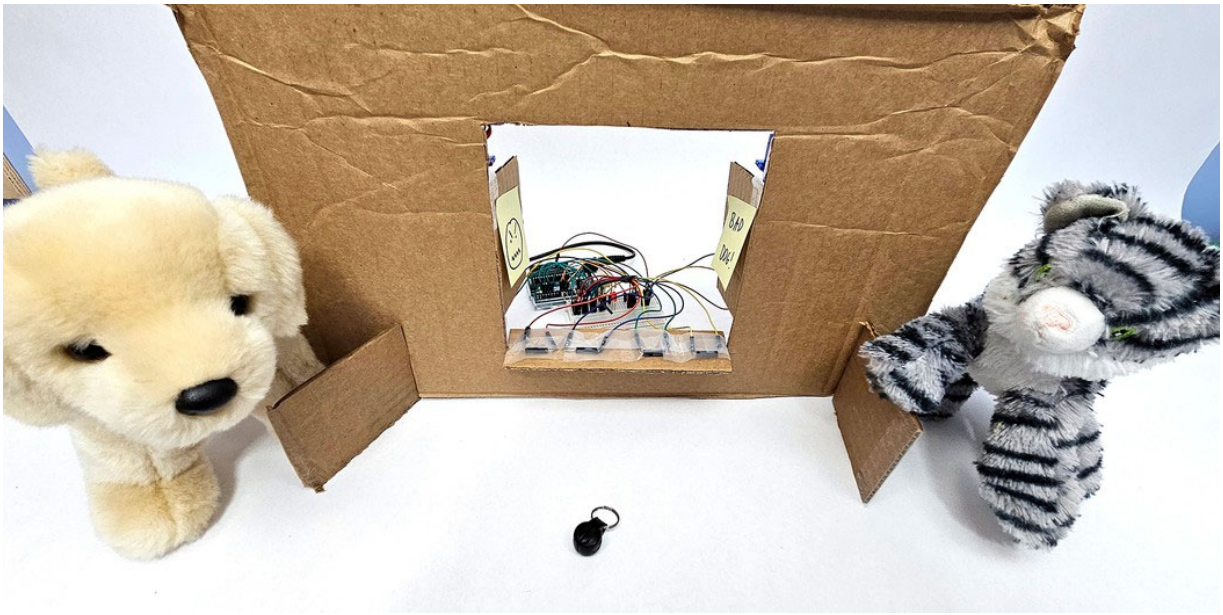
https://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p104/electricity-electronics/magnetic-pet-door (https://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p104/electricity-electronics/magnetic-pet-door)

Procedure PDF Date: 2024-02-28

Experimental Procedure

Note: This engineering project is best described by the **engineering design process,** as opposed to the **scientific method.** You might want to ask your teacher whether it's acceptable to follow the engineering design process for your project before you begin. You can learn more about the engineering design process in the Science Buddies Engineering Design Process Guide (http://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps).
Note: If you have never used an Arduino before, please see our How to Use an Arduino (https://www.sciencebuddies.org/science-fair-projects/references/how-to-use-an-arduino) page and go through at least the first three tutorials before you attempt the procedure for this project.
https://www.youtube.com/watch?v=Um0rbRKgjDM (https://www.youtube.com/watch?v=Um0rbRKgjDM)

1. Plan out your full-sized pet door (if you plan to build one), but do not start cutting any wood yet. If you just want to make a demonstration for a science project and not a full-sized door, you can build a smaller working model out of cardboard (Figure 2). You may also wish to start out with a cardboard model to test your circuit and code before you build a full-sized door.



Cardboard door flaps open or close the opening. Sensors are taped to the bottom of the doorframe, with wires attaching them to an Arduino. Two stuffed animals, a puppy and a tiger, represent pets.

Figure 2. Cardboard model of a magnetic pet door.

2. Assemble the test circuit as shown in Figure 3.
    a. Solder extension wires to your reed switches. Wrap the connections in either electrical tape or heat shrink tubing. Do not mount the reed switches to anything yet.
    b. Connect one end of each reed switch to an Arduino digital pin. In the diagram, the four reed switches are connected to Arduino pins 2, 3, 4, and 5.
    c. Connect the same end of each reed switch to ground with a 10 kΩ pull-down resistor.
    d. Connect the other end of each reed switch to 5 V.
    e. Connect an LED to Arduino pin 8, in series with a 220 Ω current-limiting resistor to ground.
    f. Connect each servo motor's ground (brown) wire to ground and power (red) wire to 5 V. Use extension cables as needed, but do not mount the servos to anything or build doors yet.
    g. Connect the servos' signal (orange) wires to Arduino pins 9 and 10, respectively.

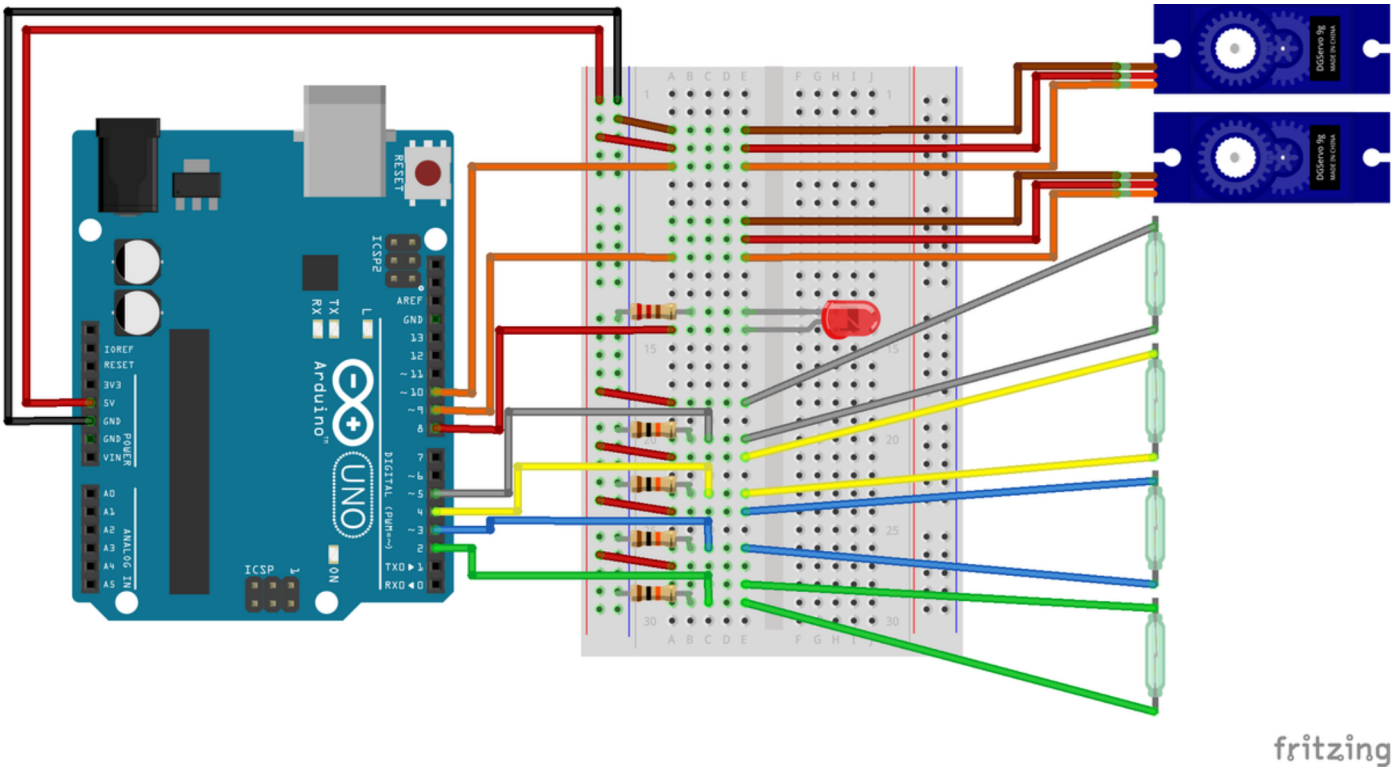


Figure 3. Breadboard diagram for magnetic pet door.

3. Download magnetic_pet_door.ino (http://www.sciencebuddies.org/cdn/Files/20231/3/magnetic_pet_door.ino) and upload it to your Arduino.
4. Hold one of the magnetic collar tags near one of the reed switches. The LED should light up and the servo motors should move.
5. Move the tag away. The servo motors should return to their original position.
6. If the circuit does not work, double-check that all of your wiring matches Figure 3. The example code will not work properly if you use different Arduino pins.
7. Once you have the example circuit working, it is time to start building your door and modifying the circuit and/or code to fit your needs. Remember that this is an engineering design project, so there is no single "correct" solution. Here are some things to consider:
    a. How wide is your door? How many reed switches do you need to cover the opening? The reed switches have a fairly short range (roughly a few centimeters). If the gaps between the switches are too large, a pet might be able to slip through undetected. If you add too many switches, however, you might start to run out of Arduino pins. You may need to experiment to determine the optimal number of reed switches and their orientation. (The switches in Figure 2 are all parallel to the door opening. What happens if you mount them perpendicular?)
    b. Where do you need to mount the reed switches so they are at the right height to detect the collar tags? In our design, we hot glued the switches to a second piece of scrap wood so we could easily adjust their height if needed. Do you have multiple pets of different heights that will use the door?
    c. Do you want your door to be closed by default or open by default? Our door is built and programmed to be open by default and to close when a pet with a magnetic collar tag approaches. Can you figure out how to reverse this behavior by changing the code?
    d. How will you build the physical doors? Our video shows one approach, using top-mounted servo motors to rotate doors made from popsicle sticks, cardboard, and wooden skewers, with metal eye hooks acting as a hinge at the bottom. But that is just one way to build a door. Remember that safety for your pet is a top priority. You do not want a pet to be injured by a heavy wooden door that closes on them accidentally.
    e. Cardboard doors (and all the electronics) are not waterproof, so our design is best used indoors. Additional effort would be required to weatherproof the door for indoor/outdoor use.
8. Modify the circuit and code if needed—for example, to add more reed switches or change the servo behavior.
9. Build your physical door. *Important: Get an adult to help you use power tools.*
    a. Cut a piece of plywood so it fits wherever you need to mount it—in an existing door frame, for example.
    b. Cut a hole in the plywood the size and shape you need for your pet(s).
    c. Build the pet doors, mount the servo motors on them, and attach them to your pet door frame.
    d. Carefully determine where to mount all the electronics and route the cables–you do not want a pet to trip and rip out all the wires! The design in Figure 1 uses a combination of clear packing tape and staples to hold the wires flat against the cardboard. *Note: Be careful not to puncture the wires with staples.*. You may need additional protection or covers if you have a pet that might try to chew or rip out the wires.
10. Test your door by holding a magnetic collar tag up to it by hand. Make sure everything still works. Test each of the reed switches individually, one at a time. If an individual reed switch is not working or one of the servo motors stops moving, double check that none of the wires have come loose. Make sure all of the wires are secured with tape, staples, or zip ties as needed.
11. Now it is time for some real-world testing! Put the magnetic collar tag on your pet's collar and observe how they use the door. You might need to set up a camera or lure your pet through with treats so you can see them use it. Does the door work properly? If it does not open or close like it is supposed to, you may need to adjust the location of your reed switches. Make adjustments and keep testing until you can get the door to work like it should.

12. After you have it working, continue to monitor the door over time to assess its durability. Do the doors still open and close properly after a few days or weeks? Has anything come loose as a result of the repeated opening and closing? Have any of the wires been ripped out? If you plan to use the door long-term in your home, you will need to figure out how to make it more durable. Look online at commercially available pet doors and note how most of them have all of the sensitive parts (electronics, motors, etc.) encased in plastic. This is the case for nearly all consumer electronic devices. This helps protect the sensitive electronics inside from dust, spills, drops, and curious animals.

Copyright © 2002-2024 Science Buddies. All rights reserved. Reproduction of material from this website without written permission is strictly prohibited.
Use of this site constitutes acceptance of our Terms and Conditions of Fair Use (https://www.sciencebuddies.org/about/terms-and-conditions-of-fair-use).
Privacy Policy (https://www.sciencebuddies.org/about/privacy-policy)