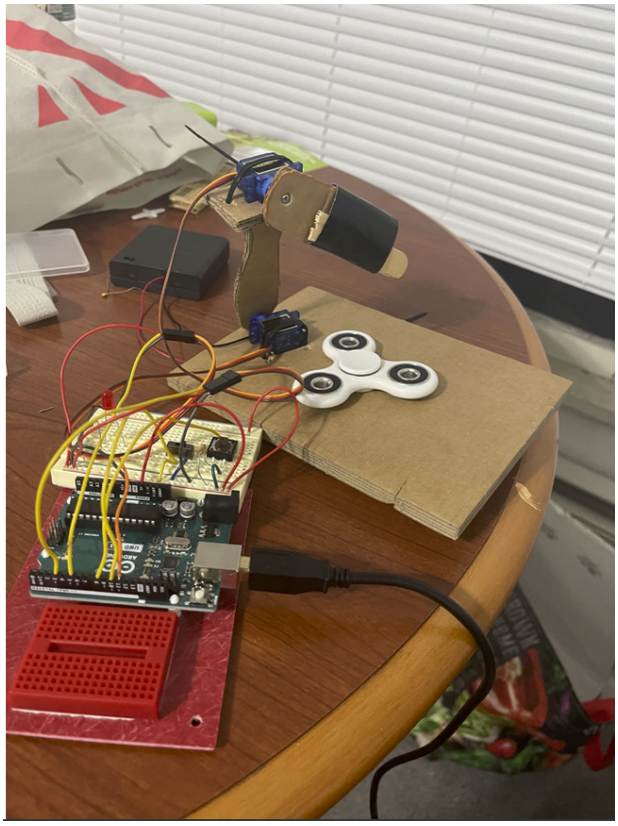
Nia Reid-Vicars
nr346

Overview:

What I built for my individual project was a robotic arm which would spin a fidget spinner in different directions. The build of my project is composed of the fidget spinner, a big arm, and a small arm. The fidget spinner is what's being spun, the small arm is what pushes the fidget spinner, and the large arm is what places the small arm in position to push the spinner. Electrically, my project uses both a button, a switch, and 2 micro servos. Once the button is pushed, the arms initialize and do the initial action of rotating the fidget spinner. And when the switch is turned on, the small arm will push forward and make the fidget spinner go faster in the same direction. The two arms are able to rotate by using the two servos. I was able to show a speed change by changing the delay of the in the code. If both inputs are on, a red LED will turn on and the machine will stop moving.



Design Considerations:

If I could do the entire project over given the same constraints, I don't know if there's much I would change. However, one thing I'd potentially change were the motors. While the position motors worked really well, I knew initially I wanted to add a speed component to my project. So I wanted to be able to show a distinct change in speed once the switch was turned. Though I could've done that with the micro servos, since the change in speed is done using delay times and not an actual function so what I would do is do some more research on motors that can not only change position but also change the speed and I would buy one of those

motor and one micro servo, of course given that it's in the price range. Or, I would've used a dc motor, and somehow figure out a way to connect that to the bottom of the fidget spinner, and have it move that way. Something else I would change given my same constraints was that I would've used harder material for the arms. Because I had used cardboard, it's hard to have the big arm stay in its initial position so it would keep falling over, so I would've used heavier material especially for the big arm, so perhaps utilize 3d printing. If I had no constraints, perhaps I would've first 3D printed all the arms since 3D printing is a bit expensive. I'd also carry over all the revisions I said before over to this new project. Additionally I'd probably add a distance sensor to the project. What the distance sensor would do is detect when the small arm is in close proximity to an object, and then it is close enough to the object, in this case the fidget spinner, the arm would do the pushing motion. What this would change is that instead of a needed looping motion and me having to approximate the angle of the arm, the sensor would just do the pushing on its own. If I were to make that type of modification, I'd probably move away from the fidget spinner, and just make a robotic arm with the distance sensor and have it push things out of the way once it comes in close contact with it.

Assembly instructions:

1. Make a base of the same dimensions or smaller as the tan base in figure 3 using cardboard or any hard surface.
2. Get your fidget spinner, a wood screw, and a drill and drill down the fidget spinner to the base. Make sure to have a screw or some type of small, circular divider to separate the fidget from the base so it can spin.
3. Begin to craft the small arm, figure 1, and the large arm, figure 2, out of cardboard or a hard plastic.
4. Looking at figure 3, you should have one motor at the bottom of the big arm and they will be connected by taking one of the screws in the motor bag and screwing in the motor to the big arm using a screwdriver.
5. For the second motor, you will place it atop of the big arm. You will fasten it by taking one of your zip ties and putting it through the two holes on the rectangle part of the big arm. See figure 1 to see the two holes. Tighten the zip tie until the motor feels stable.
6. Take your small arm, figure 2, and take another screw from the motor bag. Place the screw through the hole seen in the small arm and connect the arm to the motor using the screw. Similarly to the way you've done it for the big arm.
7. Now that you have the two arms connected to each other, start to position the jointed arm in a way where the small arm will hit the fidget spinner. See figure 3.
8. Once you've settled on the perfect placement, put two holes close to both sides of the motor connected to the bottom of arm 1. The holes should be one in front of the other not next to each other. You should have 4 holes in total, two to the left of the bottom motor and two to the right.
9. Using two zip ties secure the bottom motor to the base by connecting one right hole to one left hole and then do that again. Use figure 3 as a reference to see how the end result would look.
10. Set up your circuit and see your fidget spinner fly!

Operation instructions:

Once everything is constructed, the execution is relatively simple. When you upload the code to the arduino, the arm and servos will move slightly to initialize but then the arms shouldn't appear to be moving and the LED will be off as well. Then once the button is pushed, the big arm will slightly rotate to position the small arm, and then the small arm will gradually lower itself until it is at 90 degrees, and then there will be one big push that will rotate the fidget spinner. Then the big arm will raise temporarily and the and the small arm will raise just to lower itself again. Now, while the button is pushed, if you turn the switch on, the red LED will light up as a signal that we don't want these two things on. The robotic arm will no longer move and the light will stay on until you turn off one of the inputs. If you release your finger off the button and the switch is on, then the same action will happen just in a faster motion and that will cause the fidget spinner to move faster as well. Once both are turned off, the LED will turn off and everything will stop just to appear the same way as before the button is pushed.

APPENDIX

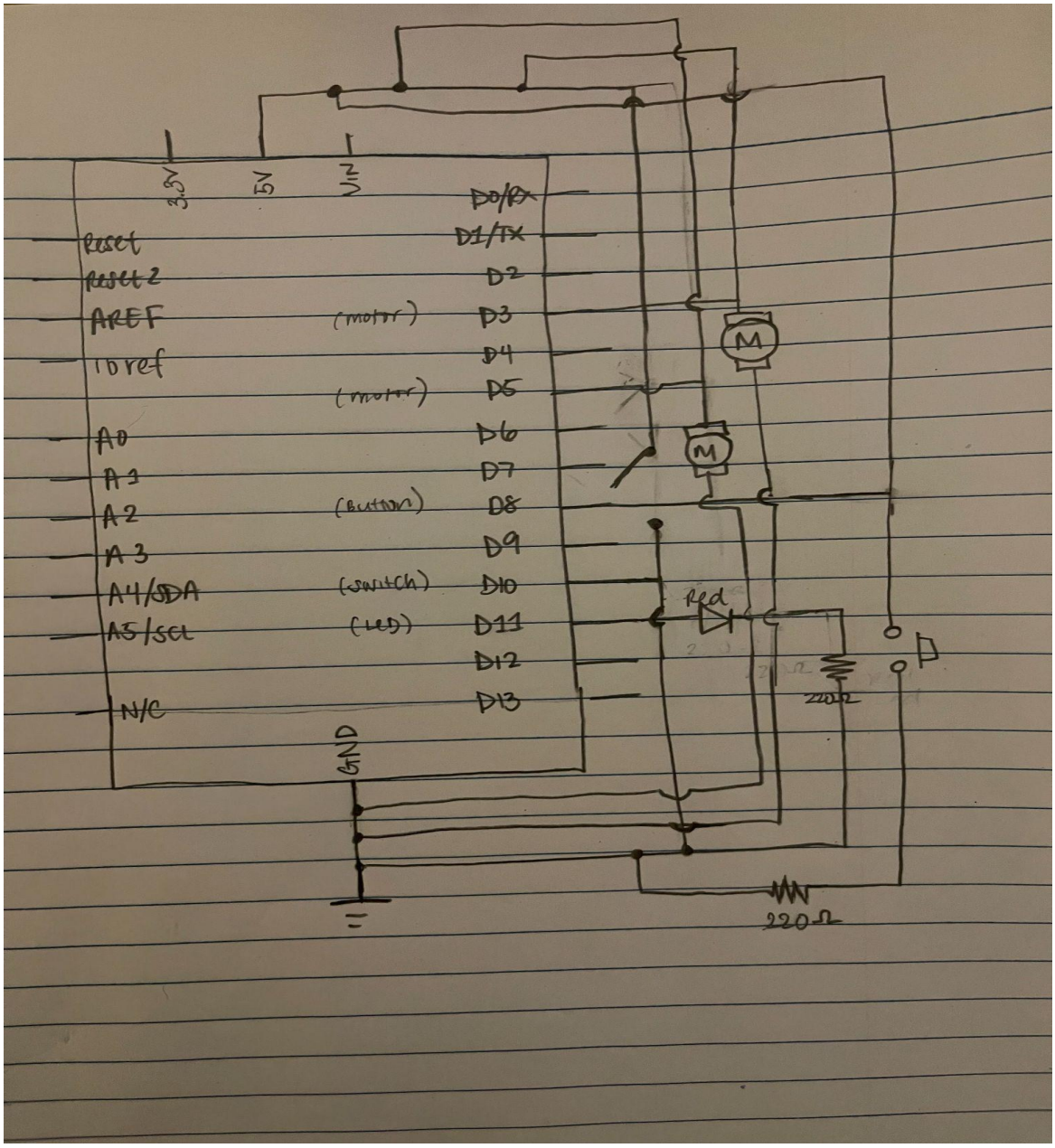
Appendix A: bill of materials (BOM):

Part Name	Vendor/ Source	Part Number/ ASIN	Quantity	Price	Subtotal
SER0006	Digikey	1738-1385-ND	2	3.62	7.24
100 8 inch pieces Cable Zip Nylon Heavy Duty Self Locking Wire Ties	Amazon	B088DM8TP1	1	3.14	3.14
Fidget Spinner	Scavenged/ mine	n/a	1	2.20	2.20
5" x 7" x 1/16" cardboard	Purchased in lab	n/a	8	0.11	0.88
Tongue Depressor	Purchased in lab	n/a	1	0.03	0.03
Wood Screw	Purchased in lab	n/a	1	0.01	0.01
LED	In lab kit	n/a	1	0.05	0.05

Resistor	In lab kit	n/a	3	0.01	0.03
Push Button	In lab kit	n/a	1	0.35	0.35
Mini Slide Switch	In lab kit	n/a	1	0.50	0.50

Total (everything): $18.35
Total (scavenged and purchased): $17.30

Appendix B: circuit diagram:



Appendix C: CAD files and drawings:

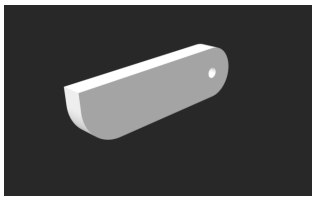


Figure 1: small arm part was cut of cardboard and about 4 ½ Inches long and 3/16" thick.

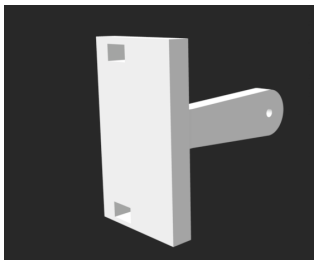


Figure 2: big arm. The big arm was also composed of cardboard and was made of two parts. The long, curved bottom which is ½ An inch thick and 3 ½ long. And a small 1 ½" x 2" x 3/16" rectangle

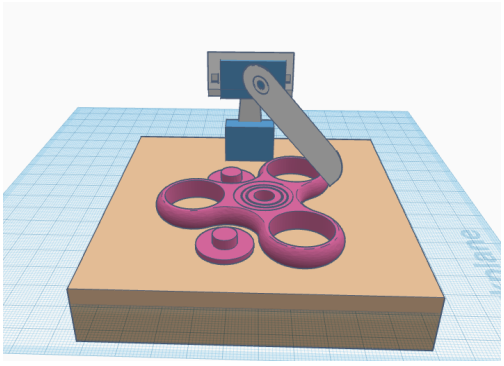


Figure 3: Full cad file, fidget spinner and connected to the base block (tan). The base is 5" x 7" x 5/16". Blue blocks are the motors.

Appendix D: commented Arduino code:

```
//code to create a robotic arm to push fidget spinner continuously. Depending on what is turned
//on, fidget spinner will rotate faster. If button is pushed, fidget spinner moves at regular speed
//and if switch is turned on arm will move faster thus making spinner go faster.

#include <Servo.h>

Servo arm1; //small Arm
Servo arm2; //big Arm

void setup() {
  pinMode(8, INPUT); //button input
  pinMode(10, INPUT); //switch input
  pinMode(11, OUTPUT); //LED output
  arm1.attach(3);
  arm2.attach(5);
}

void loop() {
  if(digitalRead(8)== HIGH && digitalRead(10) == LOW ){ // button is on, switch is off
   digitalWrite(11, LOW);
   arm2.write(15); // arm 2 spins to 15 degrees
   delay(1000);
   arm1.write(0); // arm 1 doesn't just want to get the spinner turning
   delay(150);
```

```
   arm2.write(90); // arm 2 goes to 90 to have first full rotation
   delay(500);


  for(int i = 0; i < 180; i++){ // range of degrees
      arm1.write(i); //arm 1 will start at 0 to push spinner in one direction
      arm2.write(90-i/3); //arm 2 will start at 90 to push in the opposite direction. Direction will
//switch when arm 1 equals arm 2
      delay(20);
 }
  }
  //when the switch is on and the button is off, the same motion should occur, just faster,
//changed delay times to show faster movement
  else if( digitalRead(8)== LOW && digitalRead(10) == HIGH ){
     digitalWrite(11, LOW);
     arm2.write(15); // arm 2 spins to 15 degrees
     delay(100);
     arm1.write(0); // arm 1 doesn't just want to get the spinner turning
     delay(100);
     arm2.write(90); // arm 2 goes to 90 to have first full rotation
     delay(100);


  for(int i = 0; i < 180; i++){ // range of degrees
      arm1.write(i); //arm 1 will start at 0 to push spinner in one direction
      arm2.write(90-i/3); //arm 2 will start at 90 to push in the opposite direction. Direction will
//switch when arm 1 equals arm 2
      delay(20);
    }
} else if(digitalRead(8)== HIGH && digitalRead(10) == HIGH){
    digitalWrite(11, HIGH); //if both items are on, don't want robot to be running, led will be signal
//that and nothing else should happen
  }
  else{
    digitalWrite(11, LOW);
  }
}
```