

DESCRIPTION

A simple back and forth movement created by two pieces of origami placed on top of each other. Inspired by the concept of ocean waves which lull objects floating in the water back and forth, giving a feeling of calmness.

Origami made with heavyweight white paper and movement generated by an Arduino powered servo motor pulling on string attached to the top piece of origami.





FIGURE 2 FIGURE 3

PROTOTYPING

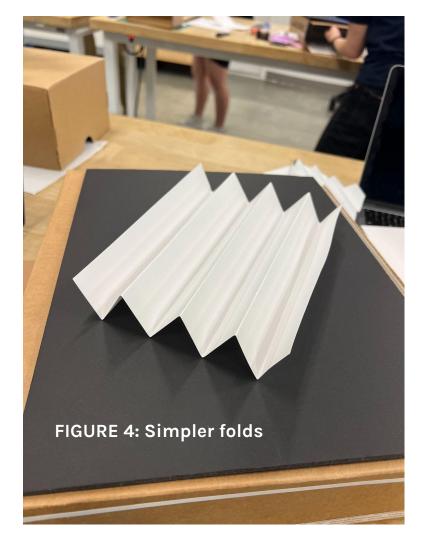
Origami designs were selected from Paul Jackson's Folding Techniques for Designers.

Figure 2's reference can be found on page 28.

Figure 3's reference can be found on page 14.

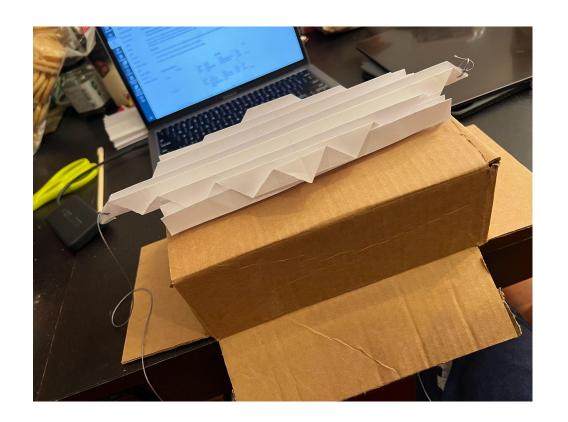
MLA Citation

Jackson, Paul. Folding Techniques for Designers. Quercus, 2011. Web. 15 Oct. 2022.



CONSIDERATIONS

Similar to Figure 3, but with less folds giving it a more elegant and simple look for the bottom piece which would be the ocean. However, this would mean Figure 2's design would have to have less folds as well, which made the overall design too simple and abstract.



MID-FI

A simple prototype to model the envisioned back and forth movement. Movement facilitated through string which was attached to the origami piece through a hole in the white paper.

CONSTRUCTING HI-FI PROCESS

Transitioning from mid-fi to hi-fi design, aesthetics are very important. Mounted final product on a black foam board and attached the origami (made with heavyweight paper) to the Arduino motor to generate the back and forth movement. Figure 6 depicts the code used to generate the movement.

Materials needed: cardboard box, cardboard, string, black foam board, paper clips, heavyweight paper, superglue, hot glue, masking tape, popsicle stick, usb cable, servo motor, Romeo BLE mini board, servo arm

```
Sweep.ino
         readme.md
      /* Sweep
       by BARRAGAN <a href="http://barraganstudio.com">http://barraganstudio.com</a>
       This example code is in the public domain.
       modified 8 Nov 2013
       by Scott Fitzgerald
       https://www.arduino.cc/en/Tutorial/LibraryExamples/Sweep
      #include <Servo.h>
11
12
      Servo myservo; // create servo object to control a servo
13
      // twelve servo objects can be created on most boards
14
15
                      // variable to store the servo position
16
17
      void setup() {
18
        myservo.attach(9); // attaches the servo on pin 9 to the servo object
19
20
21
      void loop() {
22
        for (pos = 0; pos <= 120; pos += 1) { // goes from 0 degrees to 120 degrees
23
          // in steps of 1 degree
24
          myservo.write(pos):
                                             // tell servo to go to position in variable 'pos'
25
          delay(35);
                                             // waits 15 ms for the servo to reach the position
26
27
        for (pos = 120; pos \rightarrow 0; pos \rightarrow 1) { // goes from 120 degrees to 0 degrees
28
                                             // tell servo to go to position in variable 'pos'
          myservo.write(pos);
29
          delay(40);
                                             // waits 40 ms for the servo to reach the position
30
31
32
```

FIGURE 6: Arduino code



FIGURE 7: Basic mounted servo

MOUNTING SERVO

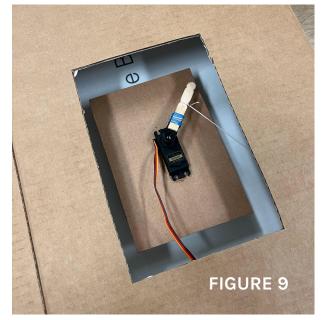
- Cut hole on bottom of box to gain easy access to work on movement mechanics
- Mounted servo to ceiling of box so it would not hinder the string pulling on the origami
- Pulled wire out through a small incision next to the motor to be able to connect to computer

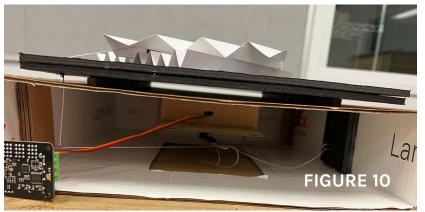


FIGURE 8: Attached servo arm to popsicle stick

ENABLING MOVEMENT

- Superglued on mini popsicle stick to enable larger range of motion
- Created a component with the string by allowing it to dry with superglue, resulting in a sturdy connection to the servo





ENABLING MOVEMENT (2)

- Created grooves in the popsicle stick to ensure string would not shift while servo is powered on (Figure 9)
- 4. Attached paper clips to sides to reduce friction of string while being pulled, padded sides with cardboard or foam to reach the needed width (Figure 10)
- Repositioned the servo connecting wire by making an incision on the top of the mounted box so it would not accidentally get entangled with the string later on (Figure 10)



FIGURE 11: Hi-Fi Prototype

https://www.youtube.com/watch?v=m0PzT4 WbM2g&ab_channel=RachelLin

REFLECTION

The hi-fi prototype has relatively smooth back and forth movement through adjustments of the servo arm rotation range. Difficulties that arose were overcoming the friction of the string being pulled on the cardboard and leveling the string to the servo height, which was achieved through the paper clips mounted to the sides of the box. This was also the most frustrating part because the string had to be fed through the mounted black form board and the shoe box which was difficult due to the nature of the small hole and was done with a wooden skewer piece. Future improvements would be to working on smoother movement, which potentially could be achieved through making the string taunter instead of being so loose or investigating the servo code more (such as the degree or delay). Overall, this project was very enriching and a great introduction to expressive origami and Arduino.