

PROTOTYPE 1: Processing + Output

PROJECT DURATION 1 week

DUE Pinup at 9:30 AM on 30 January 2008

FORMAT Your functioning prototype and clear documentation of your project should be presented on two 17" x 17" panels. It is essential to document each step of your work with digital photos, videos, drawings and diagrams.

ASSIGNMENT In this week-long project, you will begin the process of iterative prototyping. Your first prototype will quickly introduce you to two of the three essential components of responsive kinetic architecture: Processing and Output. Next week, you will integrate the third component: Input. In the following weeks, you will continue building prototypes and experiment with swapping one or more of the components and begin advanced research on a topic of your choosing.

MATERIALS

- Flexinol wire*
- Basic Stamp Homework Board*
- Transistor (2N3904)**
- Insulated alligator clips with connector wire**
- 9-volt battery
- Piano wire (0.032" thickness, or alternate)
- Basswood (6" x 3" x 1/4")
- Aluminum tubing (with hole wide enough to fit around piano wire and still have some play)
- Needle-nose pliers
- Digital multimeter (optional, may want to share among several teams)

BUILDING THE PROTOTYPE You should work with your team for this prototype assignment and for research and design projects for the rest of the semester.

The following steps are designed to be a rough guide in the creation of your prototype. You will have to interpret aspects that are not specifically covered and troubleshoot based on your specific understanding of the issues involved.

Despite the straightforward instructions, building functioning prototypes is difficult and this assignment may take some time to complete. You should not be discouraged if you encounter problems but you should work resourcefully to solve them. This process of solving problems is an essential part of the course.

* Provided by instructor

** Carried by Radio Shack (call in advance to confirm availability)

OUTPUT (ACTUATOR)

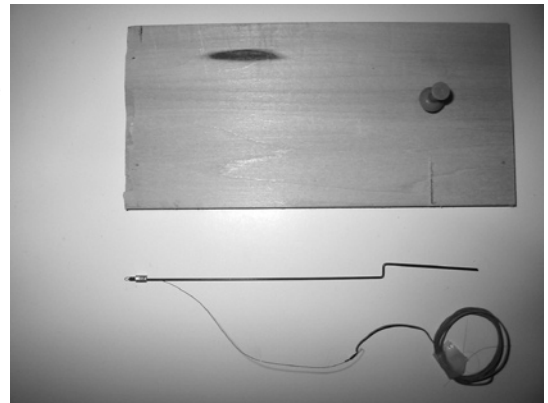
01: Attach the Nitinol wire (Flexinol) to the piano wire

Carefully detach the gray lead wire from one end of the given Flexinol wire. Cut a small length of aluminum tube (about 1/4"). Slip both the non-lead wire end of the Flexinol wire and one end of the piano wire through the length of aluminum tube and crimp the aluminum tube with needle-nose pliers. This should make a strong connection. You should be able to pull gently on the lead-wire end of the Flexinol wire and cause the piano wire to flex.



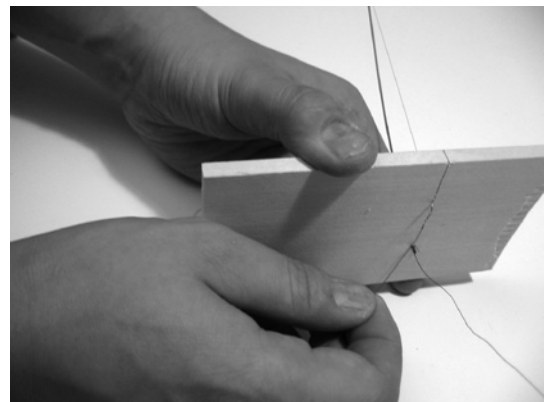
02: Prepare the Flexinol/piano wire unit and the basswood base

With needle-nose pliers, bend the piano wire as shown in the photo. The dogleg bend in the piano wire should be located five inches from the crimped aluminum tube. Make a hole all the way through the basswood base with a tack (see photo). Directly below the hole, make a very thin slit in the base (see photo).



03: Connect the Flexinol/piano wire unit and the basswood base

Insert the bent end of the piano wire into the hole. The fit should be snug. The dogleg section perpendicular to the length of the piano wire should rest on the top of the base. Then flex the piano wire slightly and slip the Flexinol wire into the slit in the base. The gold crimp on end of the Flexinol wire with the lead should rest firmly against the bottom of the base. This configuration is important because the Flexinol wire always requires a counterforce. After the wire contacts, the counterforce will pull it back into its elongated state.



PROCESSING (MICROCONTROLLER)

4: Install the microcontroller software and test serial or USB Connection

(The details of this step may vary based on the version of software in your microcontroller kit and on your own laptop configuration. The point is to establish a connection between your PC and your microcontroller.)

Obtain the Basic Stamp Editor Version 2.2 from the Parallax CD or by downloading it from the following link:



http://www.parallax.com/html_pages/downloads/software/software_basic_stamp.asp

Choose:

BASIC Stamp Windows Editor version 2.2.6 (~6.0 MB)
Windows NT4/2K/XP

Install the software.

Connect your 9-volt battery to your microcontroller, and turn the microcontroller on. Then use the serial cable or an adapter and USB cable to connect the microcontroller to your computer.

Confirm that you have installed all the software and the driver. You may see a Windows dialog box with the title "Welcome to the Found/New Hardware Wizard." Check Yes (this time only) and click Next. Check Install Software Automatically and click Next. Wait for Windows to find the driver on the CD or in the location of your download from Parallax and then click Finish.

Now open the application you have installed called "Basic Stamp 2 Editor v2.2." With your microcontroller still connected to your computer via the serial or USB cable, within the Basic Stamp Editor application select Run, then Identify. A window will appear that indicates that the program is able to see your microcontroller. The window will show that one COM port says Yes for Loopback and Yes for Echo.

5: Write microcontroller code

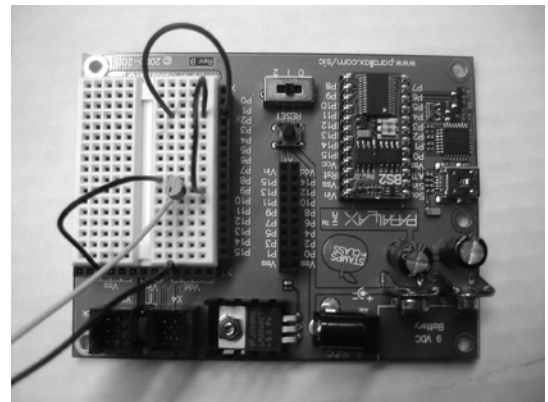
In the Basic Stamp Editor, create a new file. Type the following code in the window exactly as it appears below. Save the program and name it "OnOff". Then select Run and then Run again. This will send the new program you have written to the microcontroller. At this point, you can disconnect the microcontroller from your computer. The microcontroller will continue to run this program when connected to the power supply (the 9-volt battery), even if you disconnect the power and then connect it again.

```
{ $STAMP BS2 }
{ $PBASIC 2.5 }
```

```
DO
  HIGH 2
  PAUSE 3000
  LOW 2
  PAUSE 3000
LOOP
```

06: Create electrical circuit

On the microcontroller breadboard, create an electrical circuit exactly as indicated in the photo at right (please note that the microcontroller in the photos is slightly different than your Homework Board, but the way you create your circuit using the white breadboard and the black ports beside it should be identical to the wiring in the photo). For this task, you will have to use the transistor and the alligator clips specified in the materials list, as well as the color-coated wires that came with your microcontroller kit.



Make sure you are connected to P2 on the left side of the bread board (this is the I/O port being controlled by the program you wrote in the Stamp Editor).

Take your time with this task. It is one of the hardest parts of the project. Remember to follow the example exactly. Ask other groups for help if necessary. Look on the web. For reference, see “What Is a Microcontroller?” (http://www.parallax.com/dl/docs/books/edu/wamv2_2.pdf), pp. 259-261, but note that we are using a simple coated wire instead of the two resistors used in the reference examples. Also see the work of previous Living Architecture courses from the blogs listed under references below. Note that the earliest prototypes of these classes are at the bottom of the blogs.

**PROCESSING +
OUTPUT
(PARTIAL ASSEMBLY)**

7: Connect the partial system

With the alligator clips, connect the positive and negative signals to the gray lead wire and to the bottom end of the piano wire.

The resulting system should feature a Nitinol actuator that repeatedly turns on and off. This intermediate goal tests the Processing and Output components of the system.

