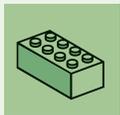


LED YO-YO SIDE CAPS



Spin-activated lights for your butterfly.

By Eric Chu

There aren't many low-budget ways to customize one's yo-yo. The most common ones are painting or dyeing; both look great, but they're limited: paint chips off, and dyeing is only for plastic yo-yos.

Being a yo-yo fanatic, I regularly visit the blog yoyoskills.com for yo-yo news. There I recently read about spin-activated LED side caps that fit into the side of yo-yos. These are low-cost (\$6) and look very cool; unfortunately, they come in only one size, thus fitting only a few yo-yos.

I thought it'd be a fun project to make my own set (and it was!). Here's my guide to making your own. I used a modern One Drop Project butterfly yo-yo, but you can choose any yo-yo that's got concave sides.

How It Works

Using the centrifugal force generated by the spinning yo-yo, the spring, acting as the switch, is pulled

MATERIALS

Yo-yo with concave sides. For more space and greater stability, pick one with a flat hub and inner rim.

Thin plastic sheet
5mm LED (2 per cap)
Lithium coin cell battery
Hot glue
Magnet wire
Double-sided tape
Aluminum insulation tape

TOOLS

Drill and #9 drill bit
Needlenose pliers
X-Acto compass cutter
Caliper
Straightedge
Pen
Sandpaper

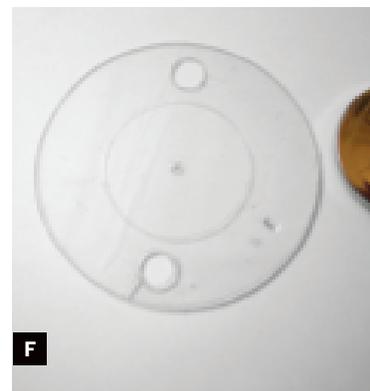
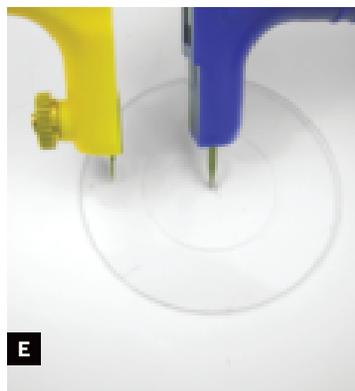


Fig. A: Calipers give an accurate inner diameter of your yo-yo. Fig. B: Set the compass cutter to match the inner radius. Fig. C: Cut the side cap out of sheet plastic. Fig. D: Measure your coin cell battery, then lightly scribe

a matching circle in the center of the cap. Fig. E: To mark the LED positions, scribe 2 opposite arcs in between the battery circle and the cap's edge. Then lay a straightedge across the center. Fig. F: The cap with LED holes drilled.

outward. It makes contact with the positive leads of the LEDs, thus completing the circuit and turning the LEDs on.

1. Cut, mark, and drill the side cap.

1a. Measure the inner diameter of your yo-yo with a pair of calipers as shown in Figure A, then divide by 2 to get the inner radius. Slide the caliper to this number and set the compass cutter to align with the tips of the caliper (Figure B). Tighten the knob on the cutter to lock it in place.

1b. Use the compass cutter to cut out a side cap from the plastic sheet (Figure C). Test-fit the cap to see if it fits into the yo-yo.

1c. Measure the diameter of your lithium battery, divide by 2 to get the radius, and set the position of the compass cutter to the radius (Figure D). Lightly mark the circumference of the battery onto the cap. Later, you'll use this to center the battery.

1d. Reset the compass cutter so that the blade is between the circumference of the cap and the battery mark. Lock it and lightly mark 2 arcs across from each other (Figure E), for positioning the LEDs.

1e. Use a pen to mark the 2 points for drilling the holes for the LEDs. To do this, place a straightedge across the 2 arcs you drew and center it on the center point of the cap.

1f. Drill out the #9 holes on your cap (Figure F). The #9 drill bit makes holes the right size for 5mm LEDs to be press-fitted.

2. Assemble the cap.

2a. Insert LEDs into the holes "bulb" first, with their leads aligned parallel to one another (Figure G). Make sure the longer (positive) leads are both facing the same direction and the shorter (negative) leads are as well.

2b. Bend the negative leads to meet each other, as shown in Figure H. Make sure they're in contact with each other. Notice that the leads are passing through the area where the battery will sit.

2c. Apply hot glue to the cap in 2 places as shown, and press the negative side of your battery onto the glue, making sure both negative leads touch the negative side of the battery (Figure I).

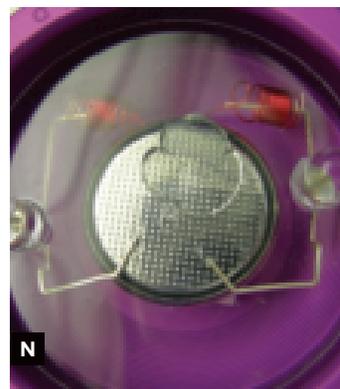
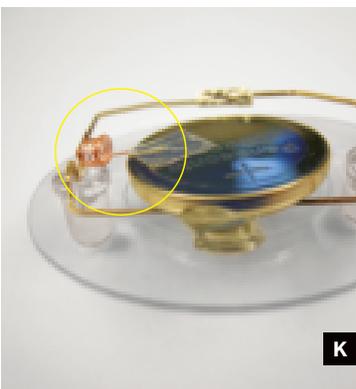
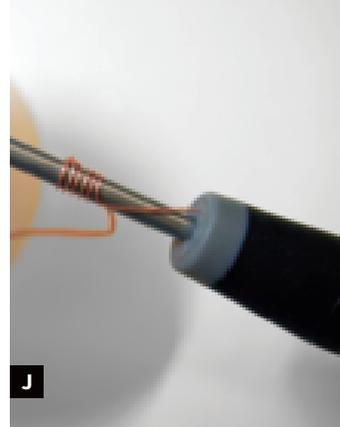
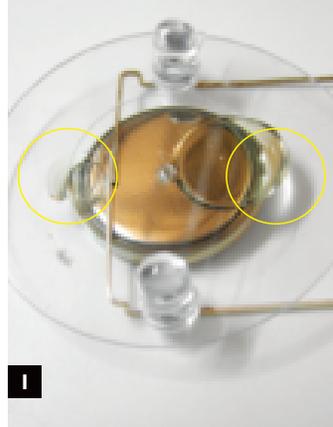
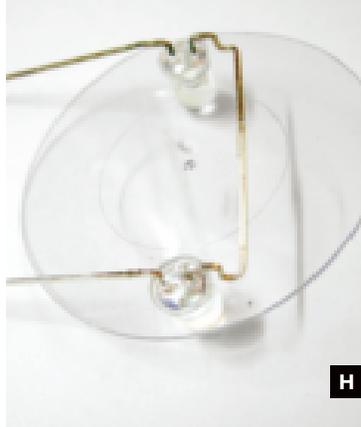
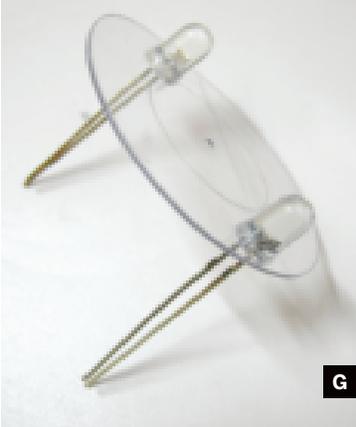


Fig. G: LEDs press-fit into holes. Fig. H: Bend the LEDs' negative leads to meet. Fig. I: Glue the battery's negative side to the cap so the negative leads are touching it. Fig. J: Coil wire around a small screwdriver to make a spring. Fig. K: With conductive tape, tape the positive leads to each other, and tape the spring to the battery. Fig. L: Double-stick tape on battery. Fig. M: Finished cap in place. Fig. N: Initial design: 2 springs, twice the trouble.

2d. Make your spring. First strip the enamel coating off your magnet wire by folding a piece of sandpaper in half and running about 3" of wire between the grit. Sand the wire until you see the bare copper, but don't over-sand or the wire might break.

Tightly wrap the wire around a small screwdriver or the ink cartridge of a ballpoint pen, leaving about 1/2" uncoiled at the end (Figure J). Coil the wire 5 times around, and cut off the spring.

2e. Bend the positive LED leads to meet each other, then tape them together by wrapping a piece of aluminum insulation tape around both leads. Tape your spring to the battery with aluminum tape (Figure K). Adjust the spring to sit as close as possible to the positive leads without touching them. Pliers come in handy.

2f. Stick a piece of double-sided foam tape onto the battery (Figure L), then stick it to your yo-yo (Figure M) and you're done!

Troubleshooting

Q: Why don't the LEDs light when I throw my yo-yo?

A: Move the spring closer to the positive leads. Check the polarity of the LEDs (+ to + and - to -).

Q: Why do the LEDs stay on after throwing?

A: Move the spring slightly farther back, away from the positive leads.

Improvements

This is my second prototype and I'm already thinking of newer designs. Using multicolor LEDs like the retail version would be a nice addition.

To keep the yo-yo spinning smoothly, make sure all the parts are centered to the rotational axis. Less mass on the caps will also lessen the wobble caused by any off-axis components.

In my first design (Figure N) the LEDs stayed lit after just one throw. Since copper wire isn't the springiest, and there was too much wire, it pulled itself toward the leads too much. Also, using 2 springs caused twice the problems!

▶ DIY LED side caps video: makezine.com/go/yoyo

➕ More on LED side caps: yoyoskills.com/?p=2608

MAKE engineering intern Eric Chu throws yo-yos and builds robots. He is the creator of Chu Pads, friction pads for bringing yo-yos back up, and is developing silicone response pads.