Budget Costume Electronics

Still more ways to make your costume glow and rotate without resorting to a soldering iron*... *(Unless you really want to)

Since I wrote "Budget Costume Illumination" in 1994, there has been an explosion of inexpensive sound and light gadgets in the consumer marketplace, as well as reduced prices on some more exotic illumination products.

Don't build it unless you have to!

A fundamental guideline I follow when putting electronics into a costume is to adapt someone else's circuitry if it lets me avoid wiring something from scratch. There are hundreds of keychain, pen, watch, and credit card-sized products available now that light up, vibrate, rotate, speak, chime and/or buzz, and most of them cost less than $40. Some of them are already designed to fit into clothing! That may sound a little pricey, but if a prepackaged item will do the trick for you, it will probably save several hours of your time. Those hours are almost certainly worth that forty bucks.

If you are going to adapt a commercial product, buy all you think you need plus one or two extra. The market life of these products tends to be brief, and you don't want to be caught short halfway through your project.

If you can incorporate the gadget intact, all the better. A coat of paint to hide the bright plastic colors, it blends into the textures of your costume, and the wiring and battery connections all remain intact. Just be sure to leave a way to replace the batteries!

Modifying a gadget can be as simple as pulling the plastic lenses off that cover the lights, a little more dramatic -- breaking it into two pieces and splicing extra wire in where necessary, or all out extreme -- gutting the gadget completely and just incorporating the guts. If you discard the casing completely, you may need to invest in battery cases or switches from an electronics shop to replace the simple bent-brass parts inside your gadget.

If you want to build your own circuits, simple is better! If you don't have a friend who does electronics, invest in a couple of simple handbooks like the "Engineers Notebooks" series of project books. Browse through the projects -- you may find a design that does exactly what you want it to!

Exotic Light Sources

In recent years several new light sources have become affordable, and you may be tempted to incorporate them into your costumes. Here are some quick comments and caveats about their use:

Halogen lamps. Halogen light bulbs burn far brighter than ordinary incandescent bulbs, and they are a bit more energy efficient, too. <u>They also burn a lot hotter than regular bulbs.</u> In my first article, I mentioned the hazard of using incandescents with thermoplastics -- I learned the hard way when the halogen bulbs melted the Friendly Plastic™ into my hair. It is also very important that you not get oil from your skin onto the bulbs -- they are made of quartz, and when hot, the oil will permeate the quartz, weaken it, and the bulb may shatter or explode.

Hi Intensity LEDs. I have nothing but positive things to say about these! While they are still more directional than incandescents, the high intensity LEDs put out astonishing quantities of light and are very energy efficient. They even come in blue, although blue LEDs are still a bit pricey.

Electroluminescent elements. The simplest example of an EL lamp is the "Indiglo™" backlight in watches. You can actually order T-shirts now that have battery packs in an inside pocket and a multicolor EL design on the front that is animated! (Do a web search on "Light-up T-Shirts" to find them). If one of those designs can work for you, spend the forty bucks on the shirt and carefully cut the electronic part out to apply to your costume. You can also buy EL pinstriping under the brand name "Californeon", and cut, trim it to shape and stick it onto any reasonably rigid surface.

Lasers: It is now possible to buy small laser diode pointers for less than thirty dollars. You can even buy "build your own laser pointer kits" that give you all the pieces you need to put the laser wherever you want in your costume. **Consider very carefully before you do so.** The diode lasers in these pointers are often powerful enough to cause irreversible eye damage, and mounting one on a

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costume guarantees that the beam will be swinging about under less than full control.

You can achieve the illusion of a laser by placing a superbright red LED behind a small hole in a black surface, in the base of a tube with a reflective inner surface (like diffraction foil), or behind a fisheye lens. If you don't need the real laser to create the effect, why take the risk?

If you do choose to install a laser, be sure to use a lens to defocus the beam, or have it strike some sort of diffuser built into the costume. Remember that unless you're in a room full of smoke, all anyone will see of a collimated laser beam is a red light on your costume and the red dot where it strikes (unless it gets them in the eye, in which case it could be the last thing that particular retina registers).

Some Notes on Electronics --

how to get that pesky LED to light up each and every time (with only a little very simple math)

LED stands for Light Emitting Diode; they come in yellow, red, green or blue. An important thing to remember about diodes (including LEDs) is that current can only flow in one direction. To make an LED work, you need a voltage supply and a resistor. If you try to use an LED without a resistor, you will probably burn out the LED. The LED has very little resistance so large amounts of current will try to flow through it unless you limit the current with a resistor. If you try to use an LED without a power supply, you will be highly disappointed. *In other words, "Batteries not included!"*

- When you buy an LED, the package will probably tell you the maximum current it can take; this will be a number of milliamperes (mA). You don't have to run the LED at max current; a typical value for good brightness is 20-30mA. Remember that a mA is 1/1000 of an amp.
- When an LED lights up, it uses typically 1.2 to 1.8 Volts. This should also be on the package. 1.4V is a good ballpark figure.
- Your battery has a fixed voltage which is probably more than the LED needs. You use a resistor to both set the current and use up the extra voltage. Here's how to calculate the size of the resistor using a simple equation based on Ohm's Law: $\mathbf{R = (V_{bat} - V_{led})/(I_{led})}$,

In other words, take the voltage of your battery, subtract the working voltage of your LED,, and divide the difference by the current you want the LED to run with. *For example, to run a 1.4V LED at 30 mA with a 9 volt battery, you need a resistor that is (9-1.4)/(30/1000)=7.6/.03= 253 ohms.*

- Think of the current like water flowing through a little pipe, and you'll realize that you can put more than one LED in a row. As long as you don't run out of volts, the same current runs through the entire line. With our 9 volt battery, that means we could run 4 LEDs in a row, but we'd need a different size resistor: the 4 LEDs will use 1.4*4=5.6 Volts, so we now need 5.6/.03=187 ohms.

By an amazing coincidence, you'll find that many of these odd little numbers are standard values for resistors. Electronics companies have been doing this for a while.

- Remember that LEDs only pass current in one direction. The longer "leg" is usually the positive one. If you are wiring several in a series, be sure that the positive leg of one is connected to the negative leg of the next, so that current doesn't get blocked.

Some very brief notes on soldering:

- Buy a decent quality soldering iron designed for electronics (30-50 watts). Soldering guns were designed for building far heavier things than solid-state electronics. Follow the instructions that come with it for "tinning" the tip.
- Use only rosin core solder for electronics.

To make a good solder joint:

1. Make good mechanical contact between the two parts.

2. With a freshly tinned tip, heat the joint. While heating it, touch one of the parts (*not the iron)* with the solder. When the solder melts, feed the solder into the joint. It should flow right into the heated

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parts. Take the iron away.
3. Don’t let the parts move while the solder cools.
4. A good joint will be bright and shiny. A “cold” joint usually looks dull and grey.

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