Dim-activated LEDs
...in flowers! ...on a hat!

W. Michelle Harris - April 18, 2014
Arduino Homago Geekouts With Howard Rheingold

Rochester Institute of Technology
Interactive Games & Media, MAGIC Center
http://people.rit.edu/wmhics
# Parts

<table>
<thead>
<tr>
<th>Description</th>
<th>Jameco.com part</th>
<th>Adafruit.com part</th>
</tr>
</thead>
<tbody>
<tr>
<td>unicolor LEDs diffused or wide angle</td>
<td>8 to 16</td>
<td>2133659</td>
</tr>
<tr>
<td>dome phototransistor, ps5022</td>
<td>1</td>
<td>2099403</td>
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<tr>
<td>potentiometer (trimmer) 5K ohm (10K works)</td>
<td>1</td>
<td>43078</td>
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<tr>
<td>NPN2222A transistor (other NPNs work)</td>
<td>1</td>
<td>178512</td>
</tr>
<tr>
<td>spdt slide or toggle switch</td>
<td>1</td>
<td>2182442</td>
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<tr>
<td>small perf protoboard</td>
<td>1</td>
<td>105100</td>
</tr>
<tr>
<td>small solderless breadboard</td>
<td>1</td>
<td>20601</td>
</tr>
<tr>
<td>9V battery snap</td>
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<td>216452</td>
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<tr>
<td>9V battery</td>
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<tr>
<td>hookup wire (22 to 24 AWG)</td>
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<tr>
<td>stranded wire (24 to 30AWG) for LED flower connections</td>
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<tr>
<td>silk flowers or ??? with small, easily removed centers</td>
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<tr>
<td>dark electrical tape</td>
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<td></td>
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<tr>
<td>large craft embroidery needle for poking</td>
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<tr>
<td>hot glue equipment</td>
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<td>soldering equipment</td>
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Prelude: transistors, generally

- electricity-controlled switches/valves
- Can turn on/off strong currents by sending a weak one to its base

Bipolar NPN transistor

http://hyperphysics.phy-astr.gsu.edu/hbase/solids/trans.html
typical use: NPN switch

Initially no current to the base, so the transistor is in the cut-off condition with no collector current.

Any $V_B$ sufficient to drive the transistor to saturation (open the "valve") will light the bulb.
Phototransistors
More light to sensor at base will let [more] electricity through

- Tune potentiometer to tune how much light will turn on LEDs

More light → brighter LEDs
A Simple and Cheap Dark-Detecting LED Circuit

Posted on December 12, 2007 by Windell

I want one strong enough for many more LEDs to light up my hat (circa '88?)
## Materials

- Hat? bag? destination
- silk flowers (3 for me)
- unicolor LEDs, 4 to 16
- dome phototransistor, ps5022
- potentiometer (trimmer) 5K or 10K ohm
- NPN2222A transistor (other NPNs work)
- SPDT slide or toggle switch
- 9V battery snap
- 9V battery

## Testing

- small solderless breadboard
- hookup wire (22 to 24 AWG)

## Building

- small perf protoboard
- stranded wire (24 to 30AWG)
- floral tape or dark electrical tape
- large craft embroidery needle for poking holes in silk
- soldering equipment
- hot glue equipment
Key Parts

- 2222a NPN transistor
- Silk flowers, I'm using 2 for LEDs and 1 more for phototransistor
- dome phototransistor, ps5022
- 9V battery-sized protoboard (this one will be halved)
- 8 or 12 or ?? LEDs
- 10K or 5K potentiometer
- switch (smaller than this)
The schematic: Dim-activated LEDs with 9V power
Testing our dim-activated LEDs

Feel free to add more LED chains (max 4 per chain depending on LED specs). Longer leg to +V. Note: The grey wires between LEDs are for schematic visibility only.

Phototransistor connection as ASCII art:
GND-----Co-----Transistor base

emitter collector
Testing our dim-activated LEDs
Testing → Assemble & Build
Flowers first!

Use a craft needle to poke holes in silk where you want LED leads to go. (Remove plastic flower centers if necessary)
Flowers first!

Insert LEDs, turning each the same way (anode-to-cathode, anode-to-cathode, ...) around the circle.

Alt: one big LED in each middle of several flowers.

Poke one flower with 2 holes and place the phototransistor.
Flowers first!

Once the LEDs are in tight, twist LED cathode to next LED's anode (leave first and last leads intact).

Don't twist the phototransistor's leads.

The LED twists will later be soldered & trimmed.

Don't twist these 2!
Flowers first!

Test connections so far by connecting battery power/ground to each LED flower to make sure it lights.
Phototransistor flower with stranded wire twisted to leads (emitter: black to ground)
Flowers first!

LED flower

Stranded wire will get soldered to the untwisted leads from flowers later.

Phototransistor flower with stranded wire twisted & soldered to leads (emitter: black to ground)
Perfboard: mine is basic & too big

If needed, trim protoboard to roughly match 9V battery
Twist battery snap power to switch middle lead, and another stranded wire to switch's end lead.
Twist battery snap power to switch middle lead, and another stranded wire to switch's end lead.

Layout potentiometer and transistor at edge of board.
I managed to make the transistor and potentiometer share a couple of holes to save work.

Goal: all wiring along one edge of board (rest = space for battery)
Use alligator clips & battery to test full circuit before proceeding with more wiring.
1. Use stranded wire (light) to connect each of the long leads to each other.
2. Use stranded wire (black) to connect each of the short leads to each other.
3. Connect the phototransistor's black wire to one of the LED flowers' short leads.
1. Connect another light stranded wire to an LED long lead. This will go to the board.
2. Connect another black stranded wire to a short lead. This will go to the board.
Test with alligator leads & battery before soldering flowers' wires. Trim.
Put the switch's non-battery wire through the board beside the transistor's collector lead. Connect (I twisted) on copper side to stabilize.

Put the phototransistor's collector (not black) wire through the board beside the transistor's center lead. Connect (I twisted) on copper side to stabilize.
Put the LED long leads' light wire through the board beside the transistor's emitter lead. Connect (I twisted) on copper side to stabilize.

Put the flowers' ground wire through the board near the edge. Put the battery snap's ground wire through the board beside it. Connect (I twisted) on copper side to stabilize.
Do one more test with the battery connected before soldering the back of the board.
A couple more flowers to fill in around the edge, and it is starting to look like something...

My finger is covering the phototransistor to cause "dim"
Next:
hot glue insulation
Next: hot glue insulation
Only a couple more to go...
Then tape
Tape the back and enough of the top to stabilize flowers.
Tape the back and enough of the top to stabilize flowers
You might be finished

A binder clip or two, plus a strip of tape to hold down the battery, might work well enough to secure this to your destination. Party on!

... but I need a bit more : )
Battery pocket & pinning anchor

From some cover-suitable fabric (old shirt), cut out one 3"x8" (or fold and cut 3"x4") rectangle, and one 3"x4", precision not necessary.
Fold the smaller piece, and place it across the larger, centered about 2" from the end.

This side will be the outside of our pocket.
Fold the smaller piece, and place it across the larger, centered about 2" from the end.
Sew 3 sides to make a battery pocket slightly wider than battery (we're going to turn it inside out.)
Trim fabric, leaving about $\frac{1}{4}$ " overage. Invert pocket.
We can glue this pocket to the back of board (padded side out for hat pinning)

This unpadded side will be glued
If your glue gun gets really hot, stick a pair of slightly-opened scissors (or some other spacer) inside the pocket instead of your fingers at first.
Put the glue on the back of the board, then (using fingers and/or scissors) press the unpadded side of the pocket into the glue. Make sure only 1 fabric layer gets glued. Glue any extra flowers to bare spots, too.
Pin to the hat band. Wear it somewhere dim.
Fin.