

Safe Lighting for Haunts

LED

Low Voltage Systems

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E5 Design: Darklight

# Topics

- *Haunted attraction lighting*
- LED 101: technical stuff
- Case study & lessons learned
- References

\* Source: Wikipedia

# Why is Lighting So Important?

- Sight is your major sense.
- Your set is worthless if nobody can see it.
- Purposes:
  - ✓ Illumination & focus
  - ✓ Revelation of form
  - ✓ Mood
  - ✓ Plot
  - ✓ Location & time of day

\* Source: Wikipedia

# Ways to Light Up a Haunt

## Standard lighting fixtures



Lamps



Nightlights



Flashlights



Fluorescent

## Décor lighting



Christmas lights



Neon



Black light

## Theatrical lighting



PAR lights



Micro Strip (MICS-1)

Strip



Scoop



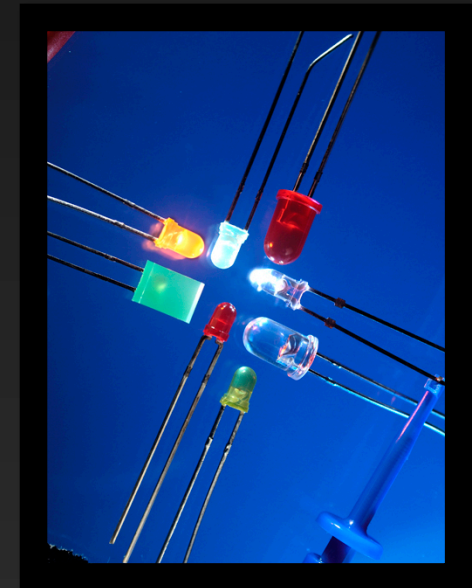
Spotlight

# Design Constraints of Haunts

- Small spaces
- Flammable surrounding
- Close contact with customers
- Modularity
- Predominantly dark
- Cost

# Why LEDs are Perfect for Haunts

- Small spaces  
**Compact:** ¼" to ½" bulbs, multi-LED fixtures comparable to standard lights
- Flammable surrounding  
**No heat:** Low voltage, low current, low power: safe!
- Close contact with customers  
**Durable:** Doesn't shatter, impact resistant, lifetime > 10 years!
- Modularity  
**Portable & Flexible:** With right system, plug and play, all colors
- Predominantly dark  
**Lights up small areas:** Suitable for dark environments
- Cost  
**Competitive cost:** \$1s to \$30s for most



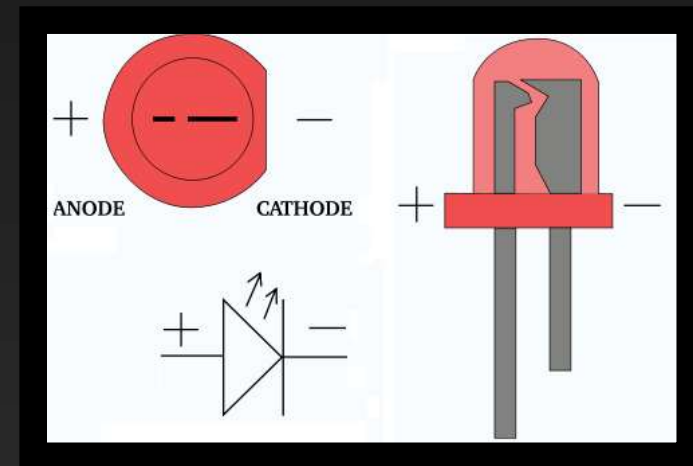


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# LED 101 (1)

- LED = Light Emitting Diode
- Diode = electrical one-way valve: **polarity matters**
- Anode (+): long leg,  
Cathode (-): short leg
- Direct Current (DC)  
Typically: 1.7V to 3.7V

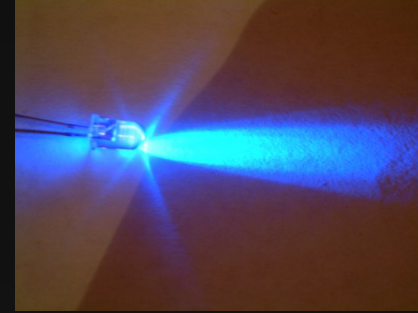


## LED 101 (2)

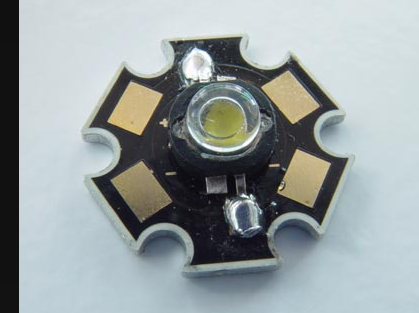
- Single point concentrated light
- Some typical LEDs:
  - 3.7V
  - 20mA



20mA:70mW



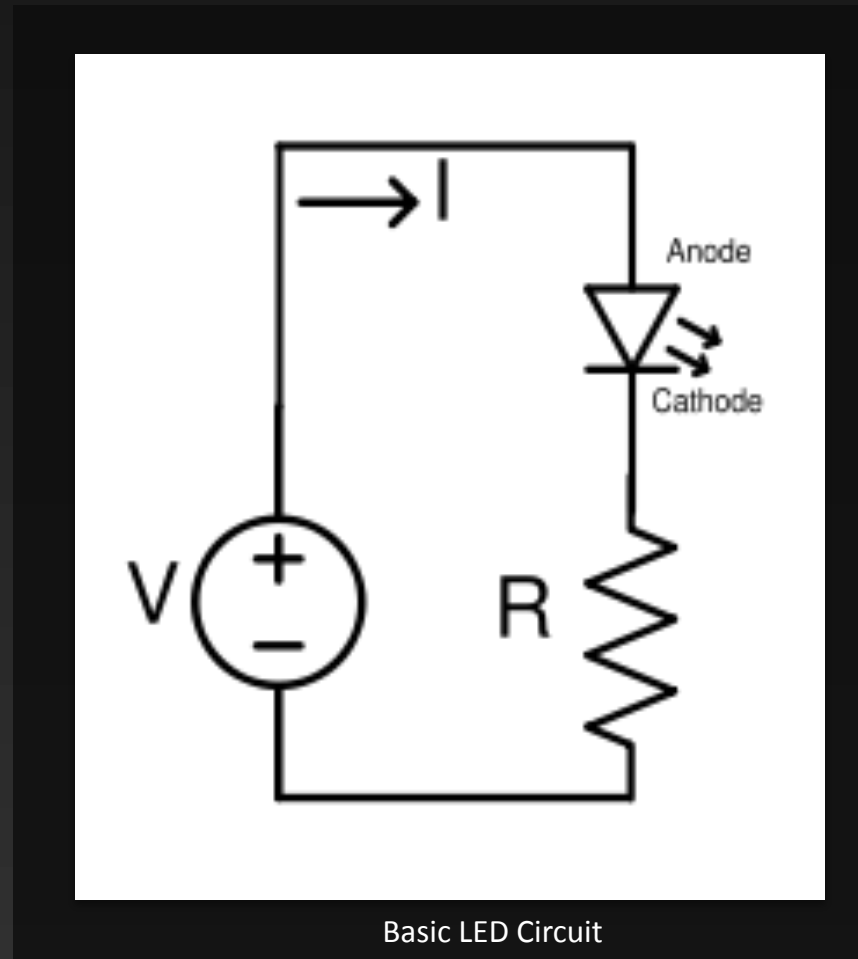
20mA:70mW



350mA: 1W

- Single LED may not be enough
- AC/DC adapters & resistors used for compatibility
  - 120V AC (transformer steps down to 12V)
  - 12V, use resistors to limit current, provides 3.7V to each LED

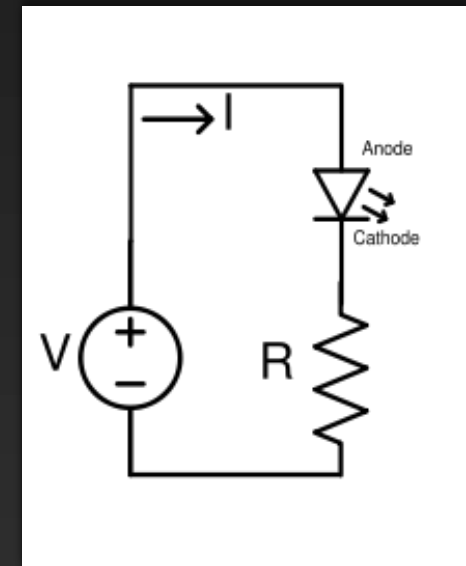
# How to Light an LED



Basic LED Circuit

# How to Light an LED

- Select DC source (12V)
- Determine LED specs from datasheet
  - Voltage drop (3.7V)
  - Maximum continuous current (20mA)
- Determine resistor needed
  - Voltage =  $12V - 3.7V = 8.3V$
  - Resistance = Voltage / Current
  - Resistance =  $8.3V / 0.02A = 415\Omega$
  - Pick next largest value:  $430\Omega$  or  $470\Omega$



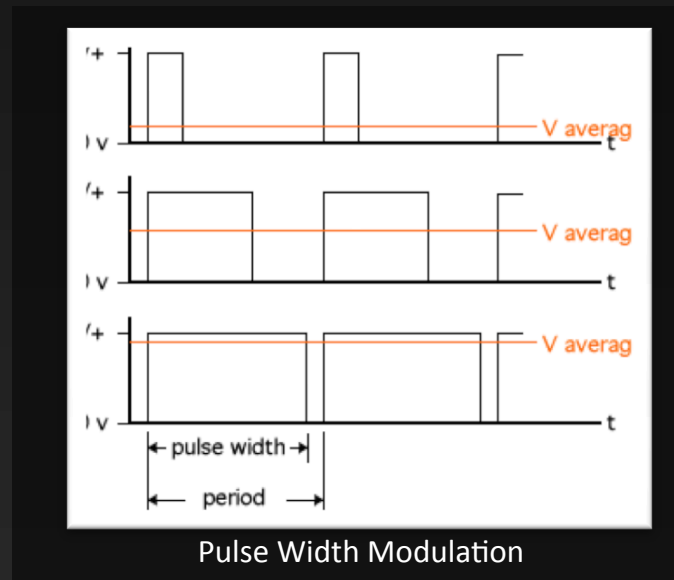
Simple LED Circuit

# Flashing & Dimming

- LEDs can flash ON/OFF very quickly
  - Animatronics controllers (relays) will work
- LEDs need special dimmers
  - Dimming = flashing VERY fast  
(100s-1000s Hz)
- Brighter: more ON time than OFF time
- Darker: more OFF time than ON time

PWM dimmers: [http://www.ecolightled.com/category/pwm\\_led\\_light\\_dimmer/?r=g\\_dim](http://www.ecolightled.com/category/pwm_led_light_dimmer/?r=g_dim)

# Flashing & Dimming



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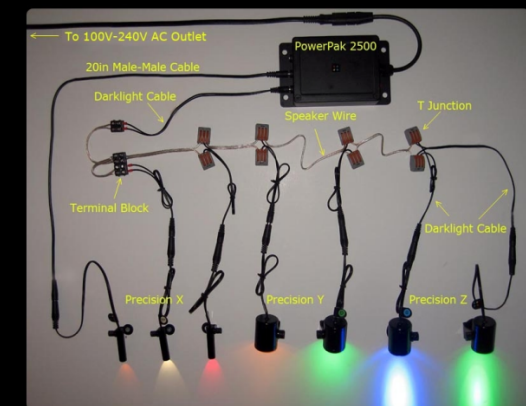
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# Types of LED lighting

- Traditional Light Replacements
  - LED PAR-Can, LED light bulbs, LED stage lights...
  - Connects directly to 120V AC
  - Good: bulbs are safe, low heat
  - Bad: \$\$EXPENSIVE\$\$ transformer in every module, cables are still 120V AC
- Low Voltage Systems
  - LED spotlights
  - Good: entire system is safe, low heat, cheaper
  - Bad: Not a replacement for EVERY application

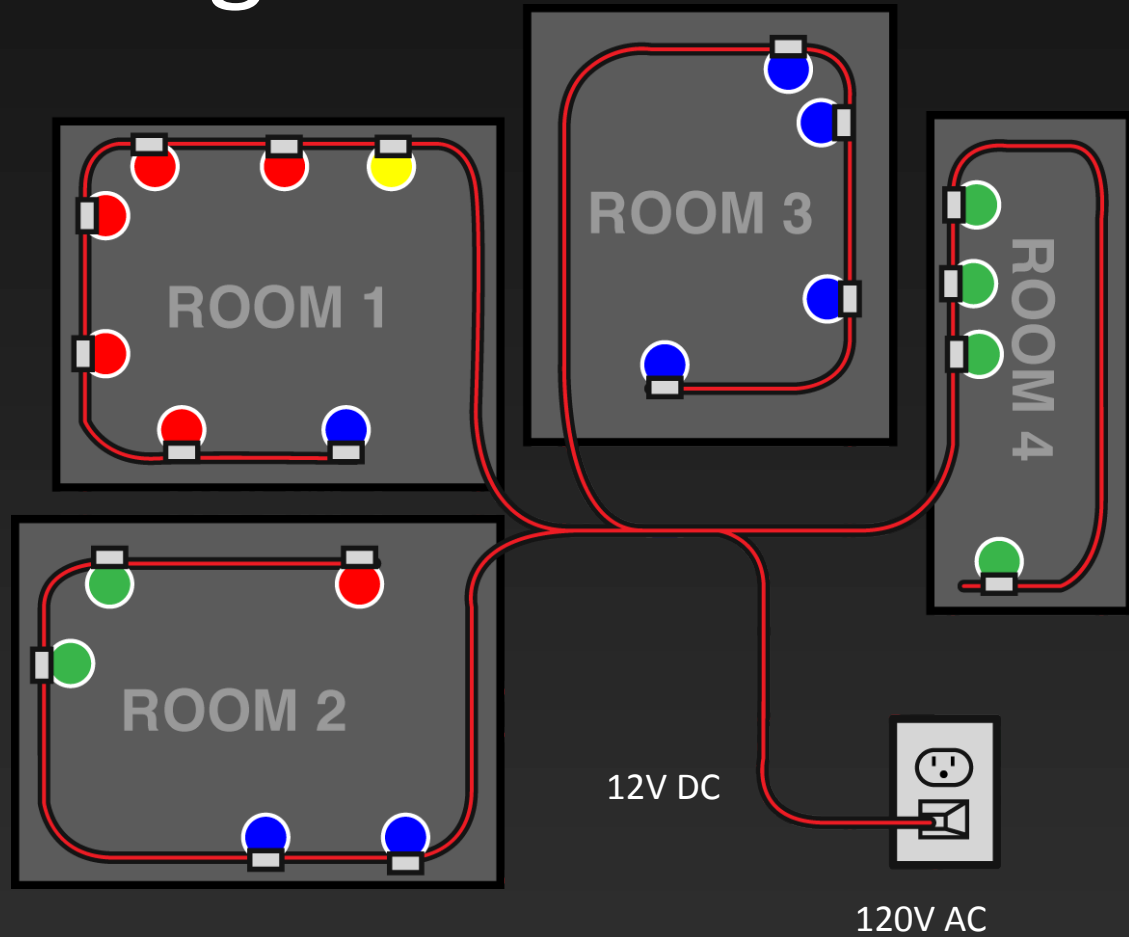


Sample Wiring Diagram

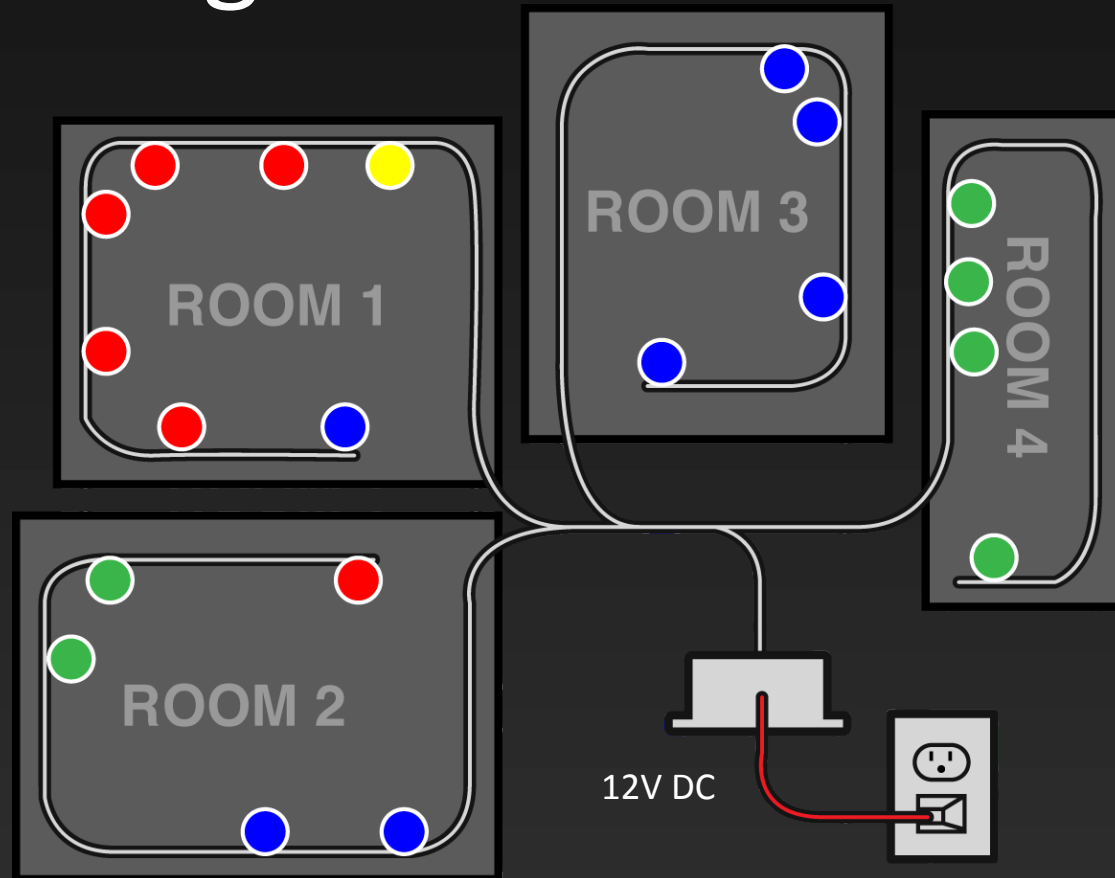




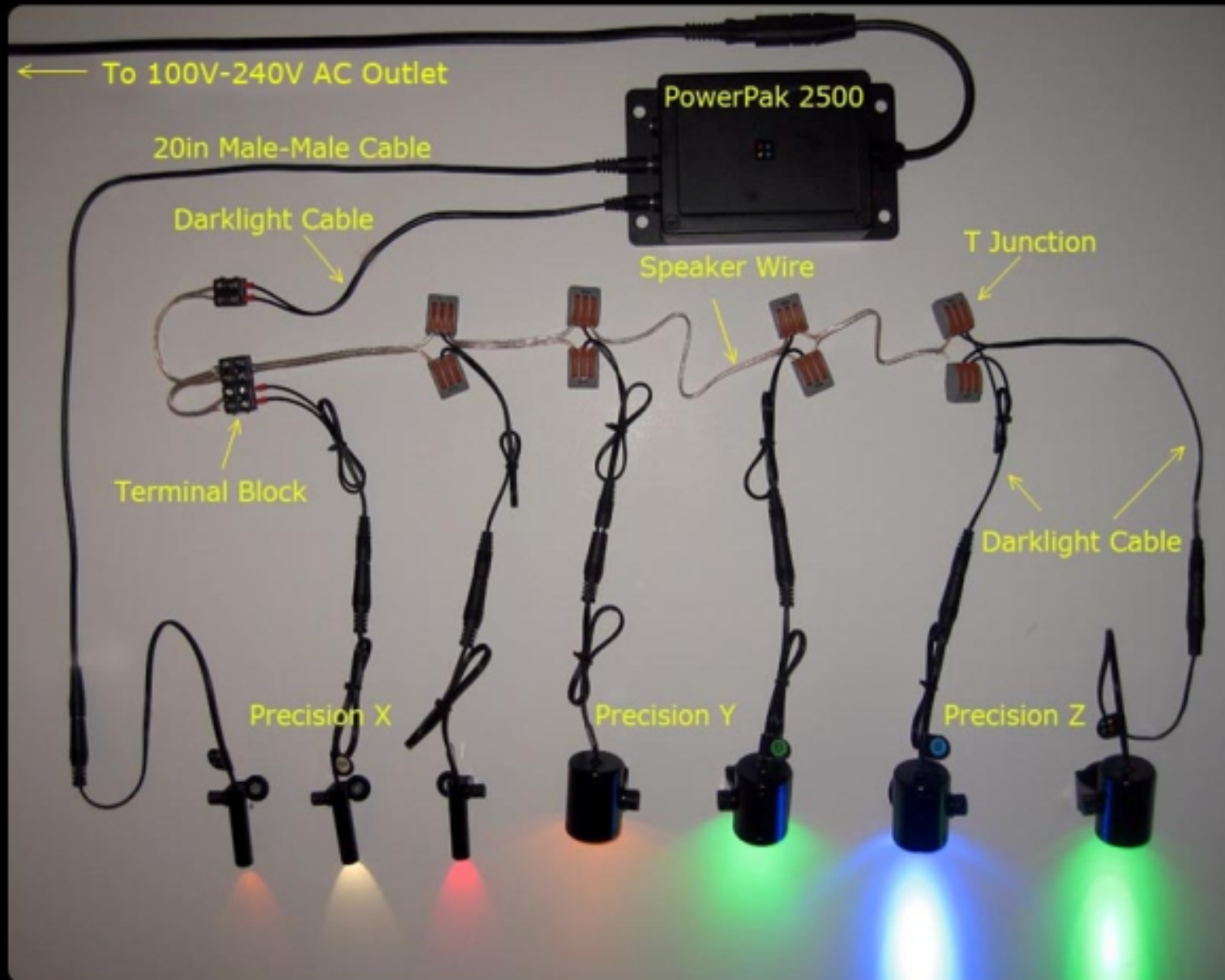
# Typical Cable Diagram



# Typical Cable Diagram



20 LEDs @ 20mA/LED= 400mA = 0.4A  
12V Power Supply > 0.4A current output OK



# Wiring Notes (1)

- Make sure PS (power supply) is adequate
  - Calculate LED total current
  - If PS not enough, use more
- Long cable has resistance (reduces brightness)
  - 22AWG, < 800ft: negligible
  - Need longer wire: go thicker, use closer PS
  - Shorter distances: telephone cable is great
- Polarity matters: red to red, black to black

## Wiring Notes (2)

- Use stranded cable if possible
  - Flexible: won't snap
  - Careful: don't short circuit
- Cable vs. Wire
  - Multi-wire grouped together = cable
  - Additional insulation = happier fire marshal

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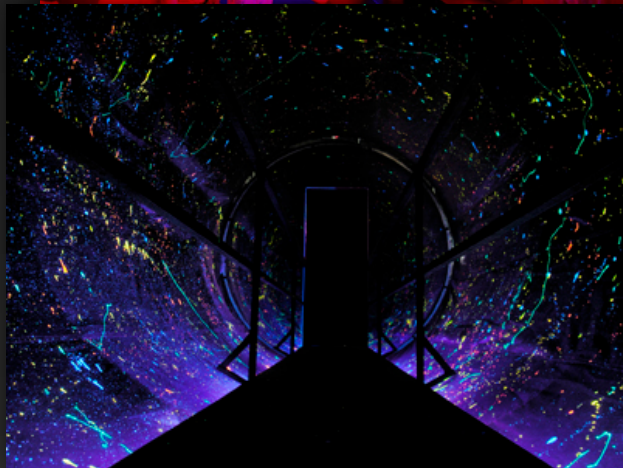
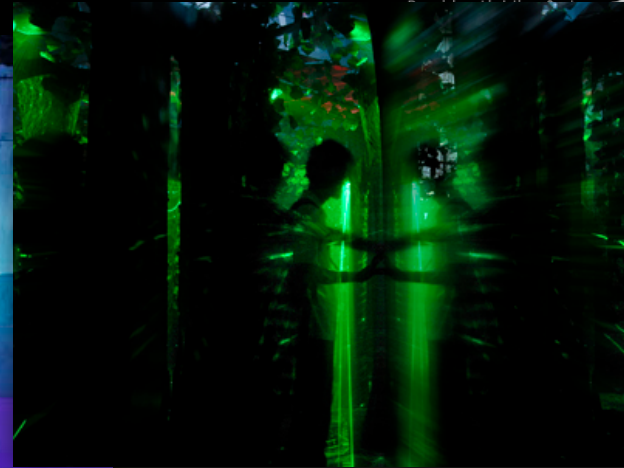
*Topic: Case study & lessons learned*

darklight™  
Precision Lighting System

# Case Study: Shanghai Nightmare

13 themes, 16 rooms (7000sqft)





- 61 LED fixtures (all 12V DC)
  - 10 bulb replacements
  - 7 high power spotlights
  - 10 wash lights
  - 34 close range spotlights
- Special lights:
  - 1 green laser (5V DC)
  - 1 siren light (12V DC)
  - 8 UV fluorescent (220V AC)
  - 1 projector (220V AC)



# Problems Encountered

- Set color was totally off with set lighting.
- Lights had to be moved around quite a bit, wires had to be cut and redone.
- Lights didn't turn on because reversed wiring.
- Many of the details were in the dark.

# Lessons Learned

- Work under set light
- Needed re-configurability: Darklight TestPak
- Needed plug & play LEDs: Darklight
- Needed idiot proof wiring: Dual-polarity



# First Haunt Ever? Rebuilding?

1. Draft layout, take “virtual tour”
2. Imagine where audience attention is, or where you want to direct it
3. Build your walls
4. Install lights FIRST
5. THEN detail your set, detail where audience sees
6. Adjust lights if necessary

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# References

- Low voltage spotlighting:

<http://darklight.e5design.com>

- LED PAR Can:

[http://www.trinorthlighting.com/Store/index.php?main\\_page=product\\_info&products\\_id=515](http://www.trinorthlighting.com/Store/index.php?main_page=product_info&products_id=515)

Discrete LED and components:

<http://ledz.com>

<http://www.digikey.com>

- Dimmers:

[http://www.ecolightled.com/category/pwm\\_led\\_light\\_dimmer](http://www.ecolightled.com/category/pwm_led_light_dimmer)