Solarpunk Parasol: A Sustainable Wearable Platform for Energy Harvesting and Passive Environmental Sensing

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Introduction

What if fashion could power your devices, shade your body, and warn you about your environment at the same time? This project presents an optional hands-free wearable parasol designed for walking, cycling and backpacking that integrates solar energy harvesting, battery-powered electronics, and passive sensing into a single accessory built entirely from materials we already had.

Figure 1. Top Side of the Parasol

Active Circuits

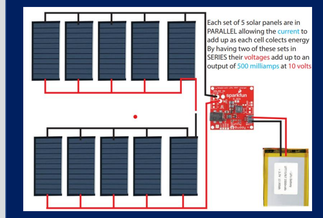

Figure 2. Wiring schematic for 10 Solar panels

Solar panels

- 5 panels wired in parallel allowing for current and to add up as cells collect energy
- By wiring in 2 sets in series we obtain an output of 10V at 500mA.
- LiPo rechargeable battery pack is used to store energy and power on board sensors and microcontrollers

Temperature Sensing & Cooling

- Temp102 temperature sensor from SparkFun
- if(temp >= 85)

```
{
  digitalWrite(3, HIGH);
}
else
{
  digitalWrite(3, LOW)
}
```

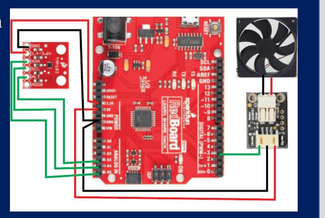

Figure 3. Wiring schematic for temperature sensor and automatic cooling system

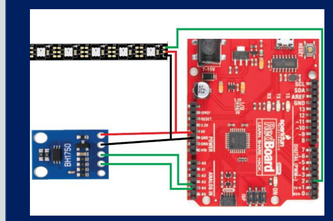

Figure 4. Wiring schematic for Ambient light sensor and NeoPixels

Light Sensing and Illumination

- BH1750 ambient light sensor
- if(lux <= 600):
  //turn on LEDs with a brightness inversely proportionate to lux value

else:
  //turn LEDs off

Structure

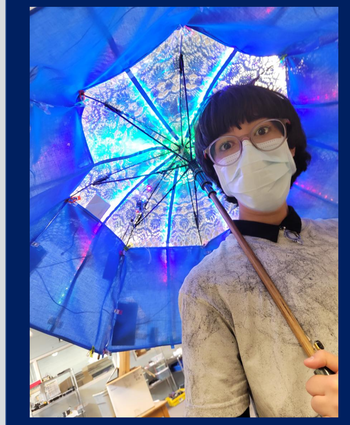

Figure 5. Underside of the Parasol

- Repurposed clear umbrella as parasol with a crocheted shade cloth
- 10 solar panels provide power for charging personal devices
- NeoPixels light up as the ambient light lowers
- Attached PC fans cools the wearer when the temperature exceeds 85F
- Passive temperature sensing shown on the tassels on each point on the parasol
- Passive UV exposure sensing and display along the circumference of the parasol
- 3D Printed clips allow the parasol to be worn on a backpack or on an E-bike

Passive Sensing and Display

Passive sensing – Reactive Pigments

- Thermochromic pigment reacts to heat
  - Tassels on the ends of the spokes of the parasol
  - Made by mixing UV Pigments with fabric medium
- UV reactive pigments display exposure to sunlight
  - Used along the edge of the parasol
  - Made by mixing UV Pigments with fabric medium

Figure 6. UV Reactive Pigment shown before and after exposure to sunlight

Figure 7. Thermochromic pigments shown before and after temperatures reach 85 F

Sustainability

- Used materials available in the engineering room
- Made use of unconventional materials like a shower curtain to create pockets for the solar panels
- Generates electricity for charging electronics and storing power in rechargeable batteries
- Functions as an umbrella and parasol
- Passive sensing displays for sunlight exposure and temperatures above 85 degrees Fahrenheit

Challenges & Future Work

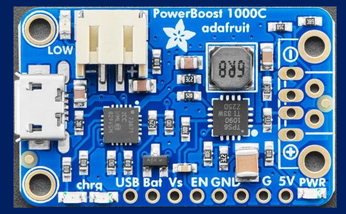

Figure 8. Adafruit PowerBoost

Heating Issues

- Current draw from LEDs causes excessive heating issues through the boost converter.

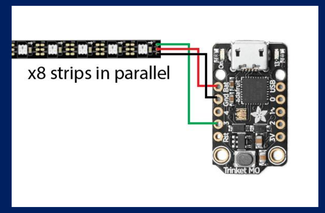

Figure 9. Current LED Configuration

Passive Illumination Systems

- Bioluminescent algae
- Moonlight Reflectors

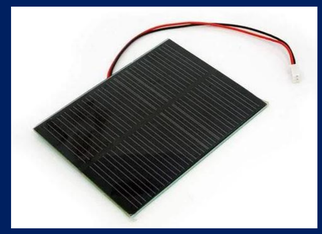

Figure 10. Desired larger size solar panel

Increase Solar Output

- 48V at 5A to charge e-bike while riding
- Integrated connector system

Acknowledgements

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