

# SMART Outdoor Lighting System for Rothney Astrophysical Observatory (RAO) Wayfinding Pathway

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## Problem Statement

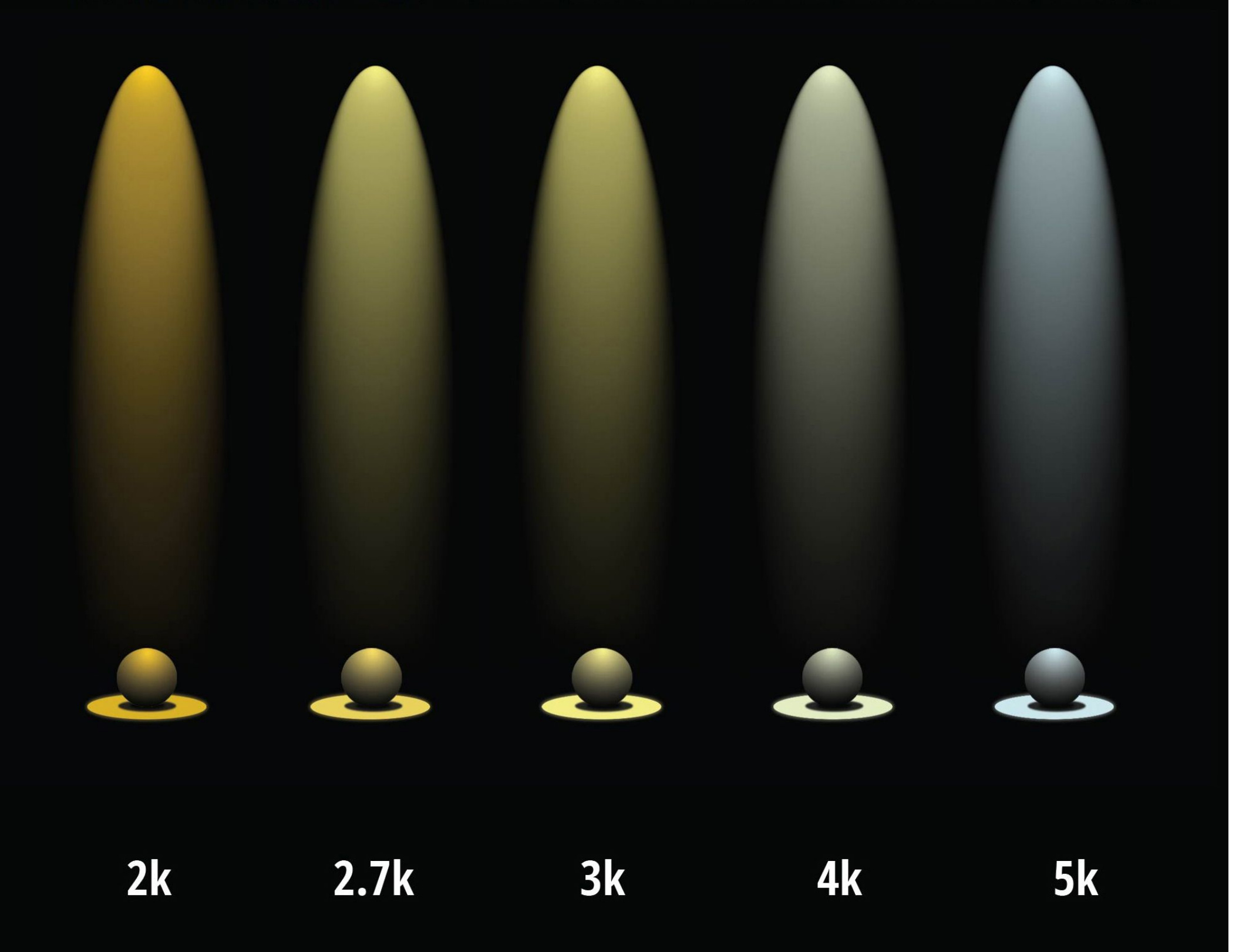
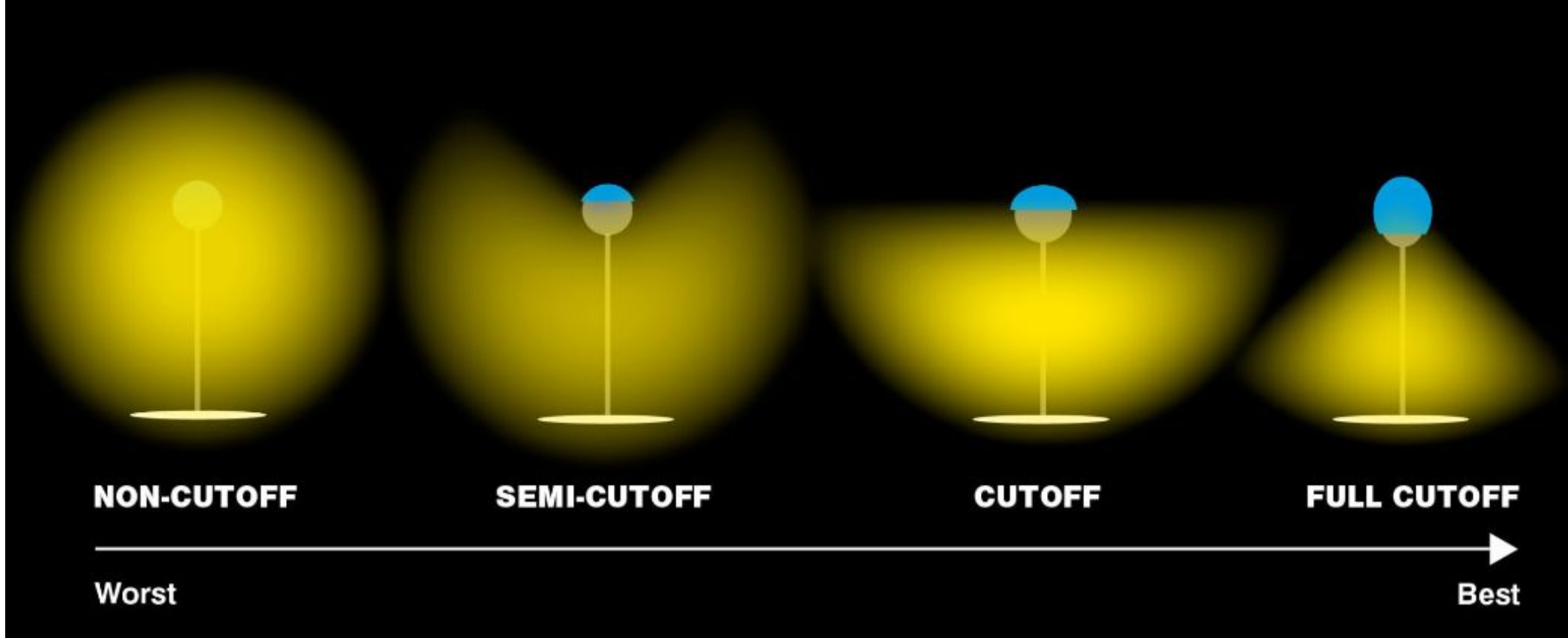
The Rothney Astrophysical observatory is a dark sky observatory for viewing the stars and other celestial wonders. Light Pollution created by traditional lights in the facility and neighboring communities negatively affects the telescopes. To address this problem while providing sufficient lighting for safe travel in the parking lot, the following dark sky standards were adopted as design constraints

- 1) Only be on when needed
- 2) Only light the area that needs it
- 3) Be no brighter than necessary
- 4) Minimize blue light emissions
- 5) Eliminate upward-directed light



## Our Solution

- Smart Lighting System (Remotely Operated) and self communicating
  - Motion sensor enabled
  - Portable and 30 Units Spaced out at 6m to 8m increments, depending on location
  - Low intensity lighting
  - Warm Orange Light
  - Smart Lighting System (Remotely Operated)
  - Solar Powered
  - Weather Proofed
- Lot Area: 3500 m<sup>2</sup>  
 Price: \$568/unit  
 Total Budget: \$18,000  
 Potential Units: 31



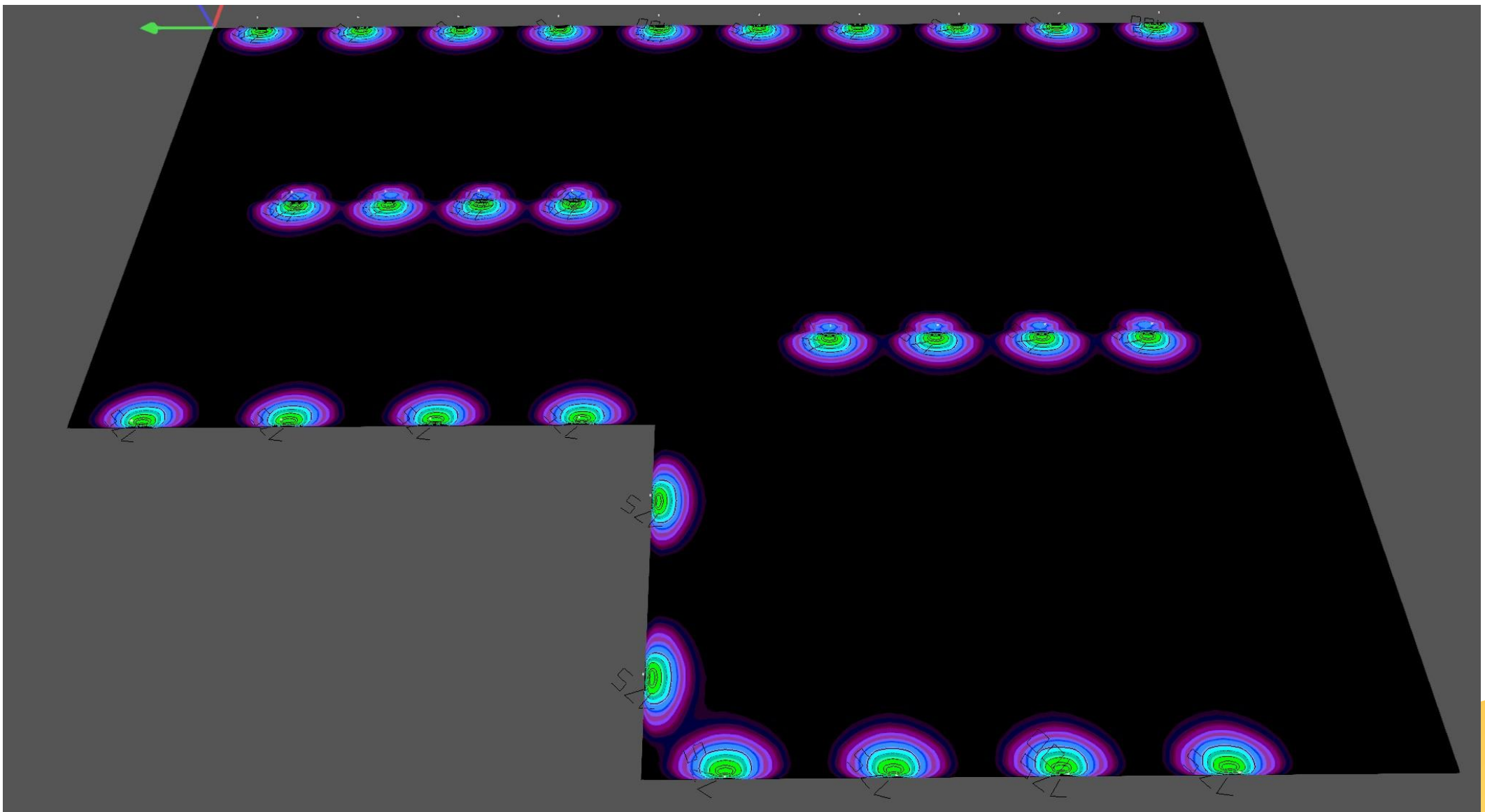
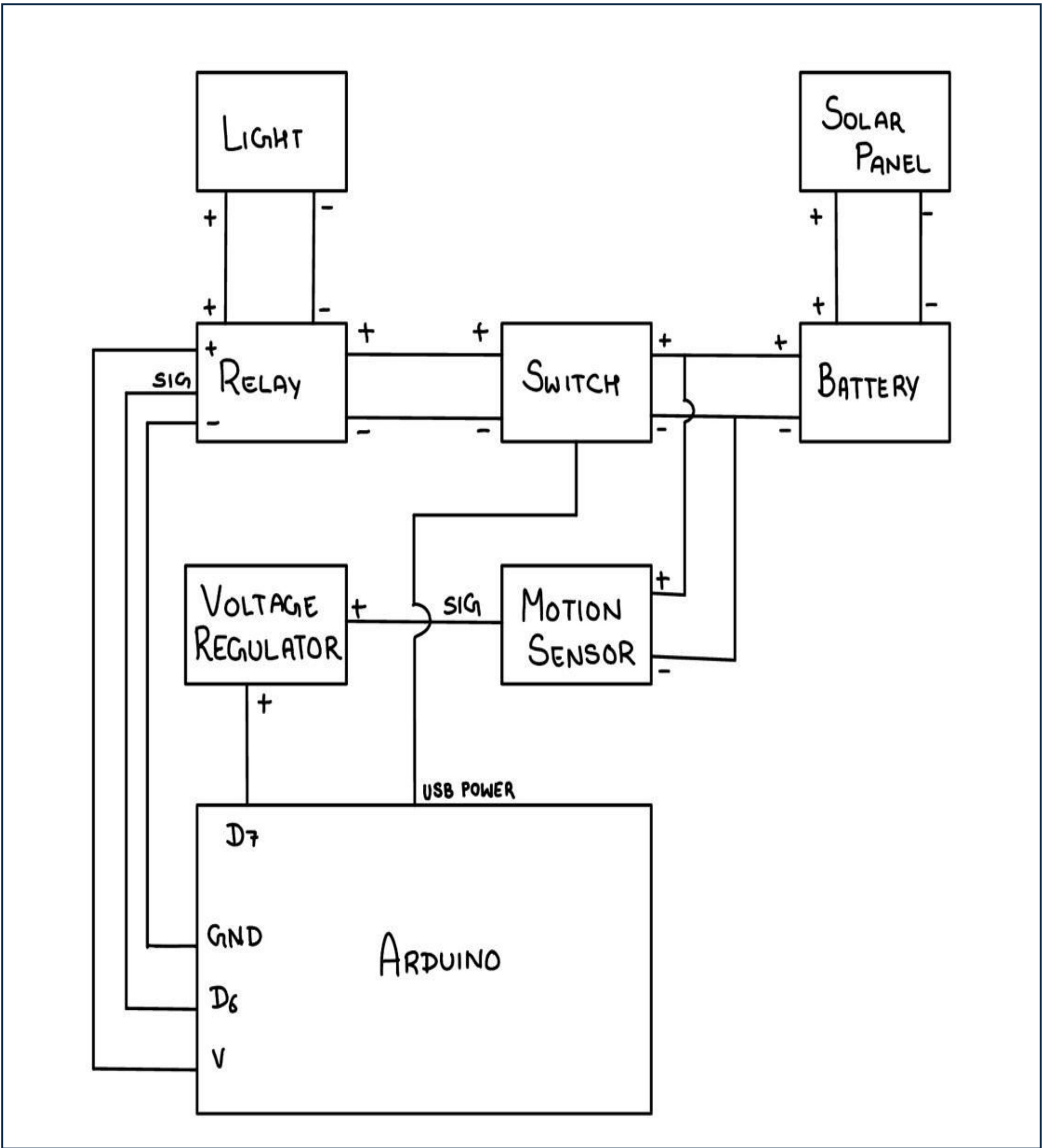
## Market Comparison

- Product Value**
- Dark Sky Friendly and low intensity design.
  - Scalable
  - Unique self-powered smart controlled lighting system
  - Environmentally Friendly.
- Potential Market**
- Driveways
  - Farms
  - Golf Courses
  - Parking Lots (with height adjustments)
  - Rural roads (with height adjustments)
  - Provincial and National Parks
  - Residential communities near observatories
- Competing Products**
- Hinkley and Kichler lighting systems
    - Low intensity light, but not self-powered and do not feature smart technology or motion sensing

## Rules & Regulations

- Foothills County Dark Sky Bylaw
- Section 4.1: Shielding
    - Full cut-off fixtures shall be installed for all exterior lighting and all fixtures shall be oriented as to direct all light below the horizon.
  - Appendix Part 1, Section 5
    - The following lamp wattages are permitted for the corresponding application, in accordance with the Illuminating Engineering Society of North America (IESNA) recommendations.
      1. 70 Watts for residential use.

## Wiring Diagram



## Challenges

- Arduino Network Setup**
- Due to limited capabilities within team, writing a code created many challenges and increased time consumed by this task.
- Light to Light Communication**
- As this required further development leveraging limited Arduino coding and knowledge, it reduced testing time availability.
- Voltage Regulation**
- System Voltage 12V +/- 1V and Arduino rated maximum 12V led to destructive testing. Problem solved utilizing a Step-down Voltage Regulator.
- Material Procurement**
- Researching and sourcing appropriate materials in a short time period.
  - Long lead items arriving close to deadlines, reducing testing capabilities.
  - Limited options with local availability, forcing compromises.

## Improvement

- Increased Testing**
- Battery Performance in Cold Weather
  - Structure Behaviour in Windy Conditions
  - Arduino Code Structure and Operation
  - Motion Sensor
- Scalability**
- Reliably Sourced and High Quality Material
    - Less Amazon, More Local
  - Constructability
    - Thicker Post - Welding
    - Wider Post - Running Wires
    - Post Cap - Metal or Built-in
    - Low Voltage DC Wiring

## Future Development

- The Team Will Provide Next Capstone Group with:
- Bill of Materials with Estimated Lead Time
  - Testing Data and Arduino Code
  - Ideas for Improvement and Scalability

## Acknowledgements

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