TEXAS STATE
INGRAM SCHOOL OF ENGINEERING

E1.01 – Integrated Camera and Lighting System

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Project Overview

Our project is an automated lighting and image-processing system built to be attached to lunar rovers. The lighting system is comprised of independently controlled lights. The image processing is done through an integrated camera that takes snapshots from a video feed of the environment as the rover moves.

Design Requirements

- ❑ The system will operate under total darkness
- ❑ The system will operate with other lighting in the area
- ❑ Camera produces quality imagery
- ❑ Image processing able to determine the percentage of light in different quadrants of the image
- ❑ Determines spotlight brightness based on the light levels determined by image-processing

Features

- ❑ HDR camera for high-quality imagery
- ❑ Lighting sampling camera
- ❑ Six independent lighting channels
- ❑ Customized drive electronics
- ❑ Automated brightness lighting system
- ❑ Spotlight and floodlight mounting system

Second Semester Goals

- ❑ Individual sub-system report complete
- ❑ Fully assembled and operating sub-systems
- ❑ Completed enclosure
- ❑ High accuracy implementation of image processing code
- ❑ Testing and validation
- ❑ Working Demo
- ❑ Stretch goal of object detection
- ❑ Stretch goal of distance detection

TEXAS space grant consortium

Top Level Block Diagram

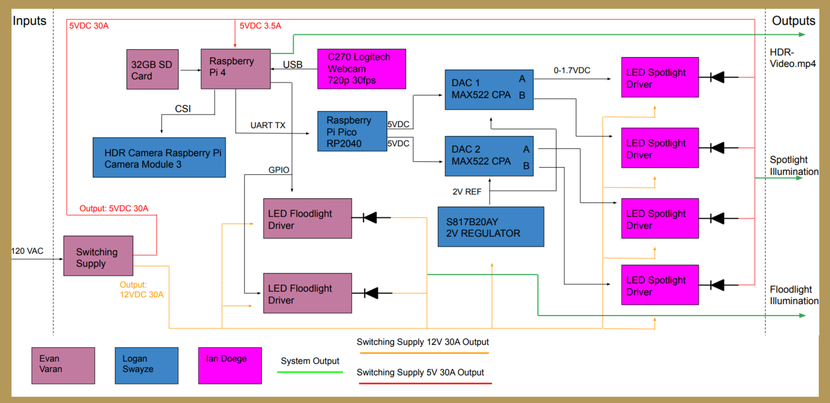
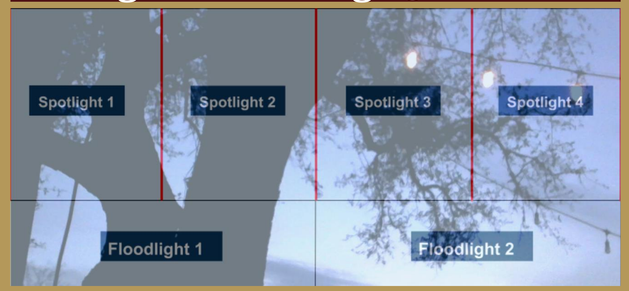
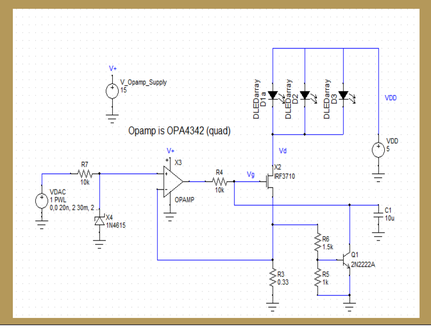


Image Processing Quadrants



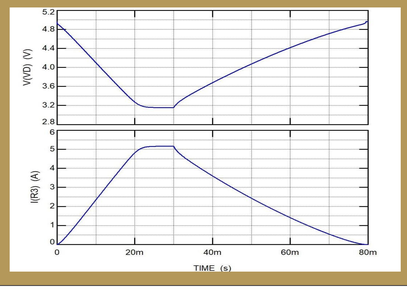
The example scene above shows the quadrants for image processing and subsequent lighting control.

Driver Schematic



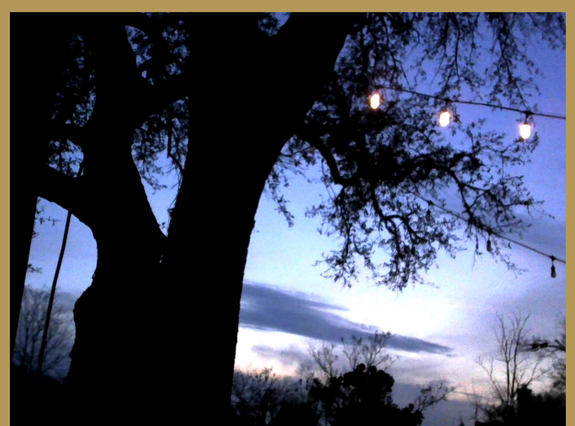
Simulation schematic of LED driver variable current source circuit.

Driver Simulation

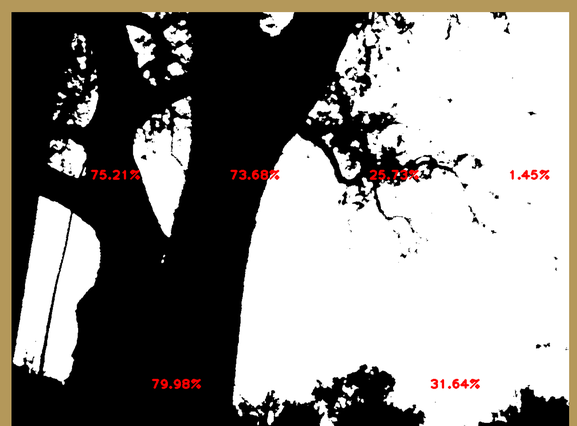


Simulation showing current-limiting feature, current-per-voltage response, and di/dt limiting feature.

Example Scene Image



Contrast Enhancement



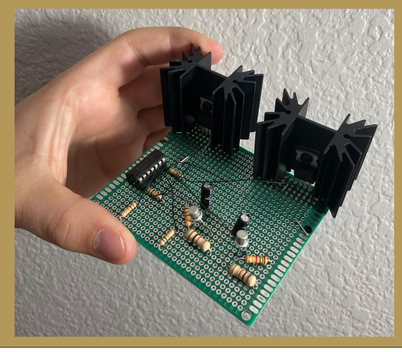
The image processing algorithm converts the scene image to the HSV color space and isolates the value channel before taking a binary threshold of each pixel. The image is then divided into the quadrants shown in the example scene image and a ratio is then taken of dark pixels to light pixels in each segment, which returns the relative darkness to control the lighting array.

Schrodinger's Bobcats

Special Thanks

Principal Investigator: Dr. Rich Compeau
NASA Sponsor: Ms. Toni Clark
TXST Faculty: Mr. Mark Welker, Dr. Rich Compeau, Dr. Jeff Stevens
NASA & The Texas Space Grant Consortium
Team Phonons & Photons
For more information:

Driver Prototype



Prototype of two LED driver channels on one proto board.

Lighting Array

The lighting array is made up of four independently dimmable spotlights and two banks of floodlights, all driven by the image processing scene data.