Light Source Locator

Software Design Document

Jacob Herr and Brian Petrich

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5. Introduction
   1. Purpose

This software design document is describing our program which will locate the most intense light source nearby.

* 1. Scope

This software aims to analyze the light sources in an environment and identify the location of the most intense source in a single dimension. If the source of light is lost it rescans and finds it again.

* 1. Definitions and Acronyms

IR - Infrared, UV - Ultraviolet, NPN - “Negative-Positive-Negative”

1. System Overview

“Light” refers to a wave in a specific region of the electromagnetic spectrum. The word can be used to describe radiation in only the visible spectrum or occasionally other regions as well (IR, UV, etc.). Important characteristics of light include frequency, intensity, direction, and polarisation. Phototransistors convert incident light in a specific range of frequencies into current and can be used to measure the intensity of that light. The phototransistor used in this project is an NPN phototransistor without the base wired to anything.This works because light releases current in the base region, which is amplified like it was injected by a base connection. If the base was connected, we would get no current flow. is mounted on a stepper motor. An NPN transistor behaves like two outward facing diodes. The N of the NPN refers to a semiconductor material that is saturated with extra electrons, while the P refers to a semiconductor material that has a lack of electrons (called holes). With some applied voltage, the electrons flow readily to a P region. The emitter of the transistor supplies electrons to the base and the power from the incident light controls their flow to the collector - more light allows more voltage to flow through the transistor. We have a resistor in this circuit (470 KOhm) and take our measurements across it by comparing Vout to ground. The stepper motor is run through a driver. The driver reverses current polarity and regulates current and voltage. The stepper motor works by permanent magnets in the rotor being rotated by two electromagnetic coils. One coil’s polarity is reversed while the other is held where it is at. This allows the motor to step precisely in small increments. The step motor rotates the phototransistor until it is pointing in the location of strongest light intensity. If the light source is lost, (if the light is sees drops 15% from the observed value) the stepper motor will rescan and find the light source again.

1. System Architecture
   1. Architectural Design

Our system runs in 3 separate steps in one module. We use only one module for simplicities sake and accomplish it with a flat sequence structure. The first step we use is to scan the full 360 degree rotation with our stepper motor, which for our stepper motor/driver combination was 800 steps. We accomplished this by sending 800 20 ms pulses to the step- pin of the driver. To properly get the step that had the highest voltage from the phototransistor we also timed(using a timed loop) 800 data points with a 20 ms delay between each data point and then made an array of those steps and their coinciding voltages. Using the Min Max vi that National Instruments supplies we sorted out the max voltage and the coinciding step(the index). We then connect those two values to our next step which sends the same number of pulses as the max index given, causing our stepper motor arrow to point towards the location it got the max voltage. The third and final step utilizes a while loop to continuously scan/take voltage values from the phototransistor until the stop button is pressed or the ratio of the new voltage and the maximum voltage is less than 15%. We time the while loop to wait 100 ms between scans to allow a buffer between DAQ measurements. If this step is stopped by the ratio falling below 15% then the while loop around the flat sequence structure causes the whole sequence of events to repeat.

* 1. Design Rationale

We designed it in a singular VI for simplicity’s sake. The code will be easier to manipulate by any future users for their own purposes. We used to flat sequence structure instead of multiple small VI’s because it allowed for an easier visual following of the steps. It also allows you to quickly pinpoint any bugs in the code. We did a timed loop for the sensor data acquisition to easily connect the iteration number with the number of steps but we also consider using a while loop and having it delay by 20 ms between iterations but ultimately found it to cause tricky array manipulation than the timed loop. Depending on the situation the amount of pulses to the stepper motor can easily be changed and is immediately visible and the ratio that the user wants before a rescan can be chosen.We chose 15% because it seemed to be the most consistent in allowing noise and momentary shade without causing the motor to just keep scanning. It only rescanned when there was a very visible change in the amount of light from the light source (ie the light source was removed)

1. Human Interface Design
   1. Overview of User Interface

The Front Panel of this VI will allow the user to begin scanning for a light source and stop the scan when desired. It also includes a graph of the voltage versus steps so the user knows if it stops at the right general step and can see the scope of intensity from the phototransistors perspective.

* 1. Screen Images





