

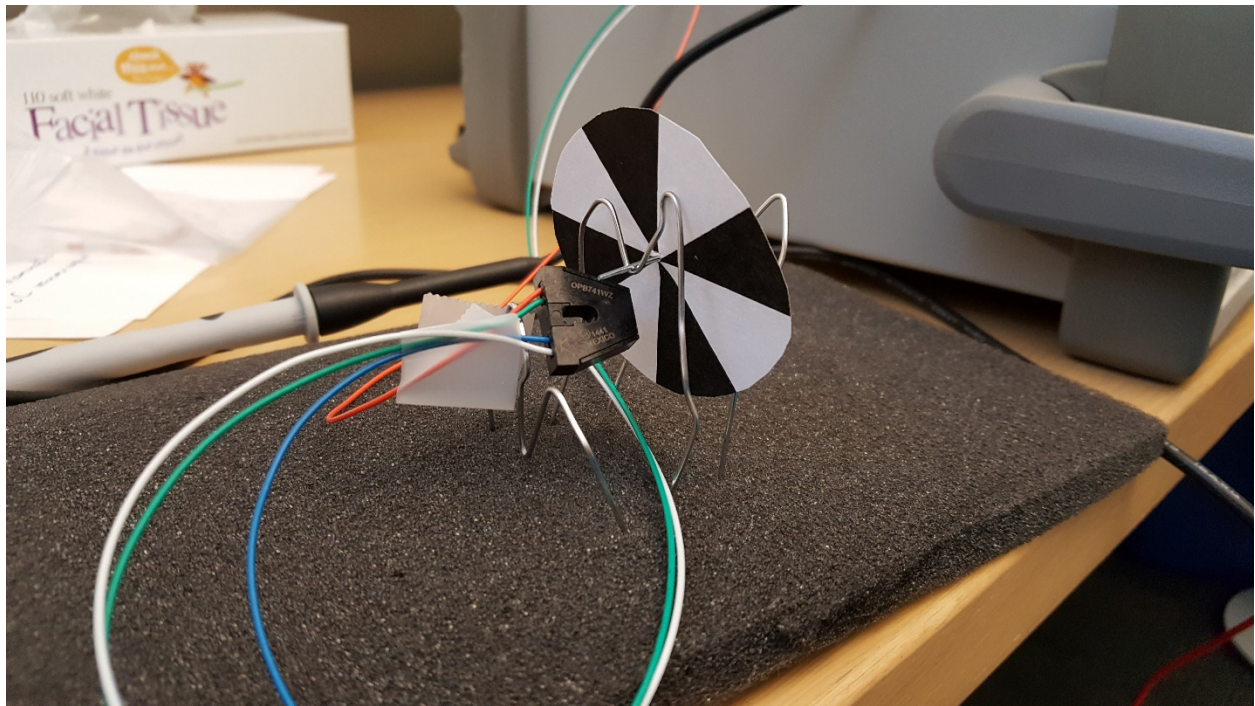
Optical Shaft Encoder

Introduction

In this lab, you will build a simple optical shaft encoder system. Optical shaft encoders are widely used to convert the mechanical operation of knobs and shafts to digital signals. The shaft is fitted with a target of alternating white and black areas. An object sensor emits light onto the target using a photodiode; it detects the light reflecting onto the target using a phototransistor. The output of the photodetector produces a signal that indicates when the target has been rotated from one area to the next.

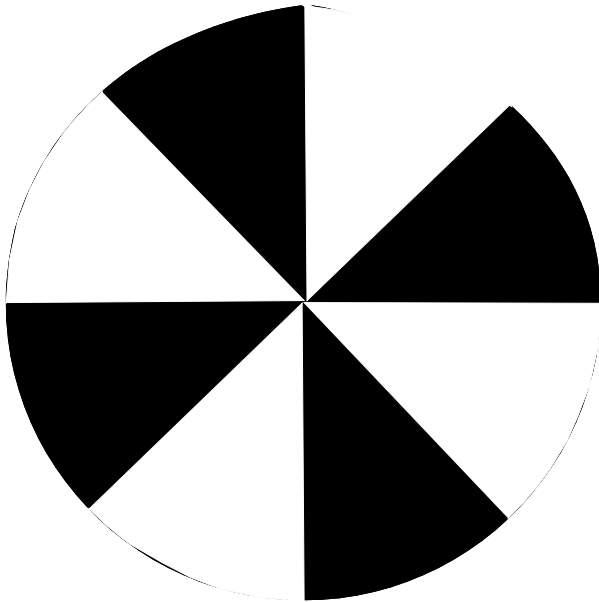
Procedure

Here is the mechanical side of your setup:

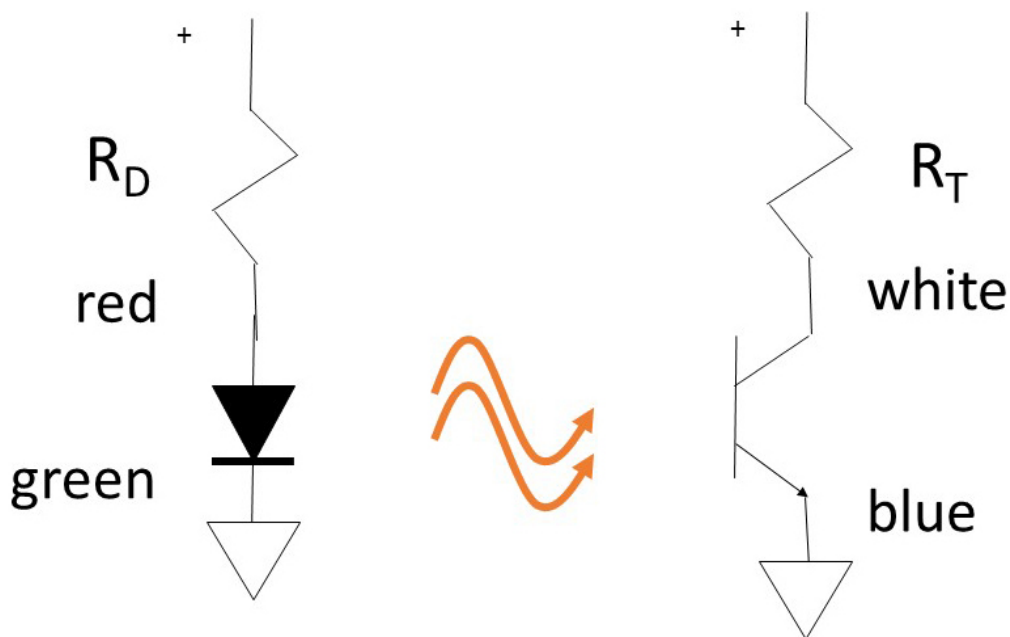


The detector points at the shaft target. The detector includes a photodiode and a phototransistor that are arranged at angles so that the light from the photodiode will be reflected back to the photodetector.

Here is the target:



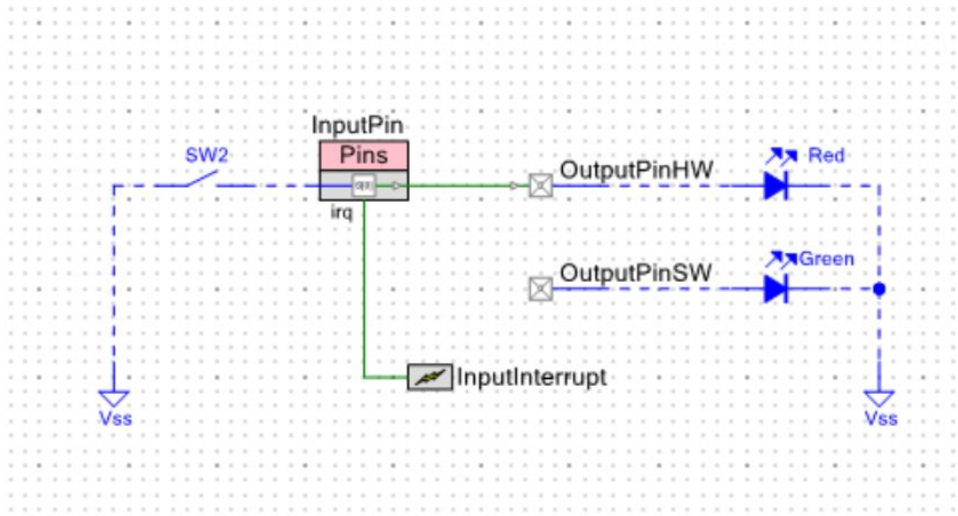
Our setup uses the OPB703WZ detector. Here is the schematic for the detector circuits with the colors of the leads from the detectors as shown:



The photodiode emits light; the optical path to the target and back determines how much light reaches the phototransistor. If enough photons reach the phototransistor, it turns on and produces an emitter-collector current.

Q1: Given a power supply voltage of 3.3V and a diode current of 20 mA, what should be the value of R_D ?

Start a PSoC Creator project using the Digital_Pin example. If Creator asks for the chip used, our evaluation board uses CY8C5868AX1-LP035. Here is the PSoC schematic from TopDesign.cysch:



The InputPin will be connected to the phototransistor output. You will use the diode connected to OutputPinHW to show the state of the phototransistor. You should use the pin configuration page on Digital_Pins.cydwr to connect the input pin to P6[0]; your proto board should be wired to use this pin. You should set the configuration of InputPin on both the general and input tabs:

Build your project. The LED connected to P6_2 should go on and off as you move the optical shaft target between black and white regions.

Q2: What is the phototransistor output voltage (white lead) when the detector points at a white region on the target?

Q3: What is the phototransistor output voltage when the detector points at a black region on the target?

Q4: Can your detector determine which way the shaft is turning? If so, justify your answer. If not, describe how to change the design to determine the direction of rotation.

Extra Credit 1: Use the LCD display to display the count of the the number of transitions detected by the circuit.

Extra Credit 2: Add an audio output that produces a click sound at each transition.

[You Should Turn In](#)

Answers to Q1, Q2, Q3, Q4.

All design documents for Extra Credit 1 or/and 2, if you completed these tasks.