Light Detection Circuit for a 650nm Laser Diode

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Introduction

A few years ago, I wanted to build “yet another training device” for my kids’ favorite sports of baseball and softball. For this device I needed a mechanism to detect when a ball broke a beam of light and the indication would need to last for a few seconds so a human could register it. Once the time period expired, the indicator would automatically reset. This paper presents the circuit that I developed along with the specifications for a compatible light source.

The Circuit

My design is based on the circuit presented by Udi Tirosh. Udi’s project was an inexpensive trigger for high speed photography and can be found at the following link:

https://www.diyphotography.net/make-laser-camera-trigger-2/

My requirements were a little more complex than a triggering mechanism for a camera. When the light beam is broken, I wanted the primary light to be on for 3 to 4 seconds and then turn off. Also, during the proof of concept phase with the breadboard, I realized that another LED was needed to indicate that the laser diode was aimed correctly at the light sensor. This secondary LED would be on when the diode was correctly aimed at the light sensor and would not have any time delays in either the on or off state.

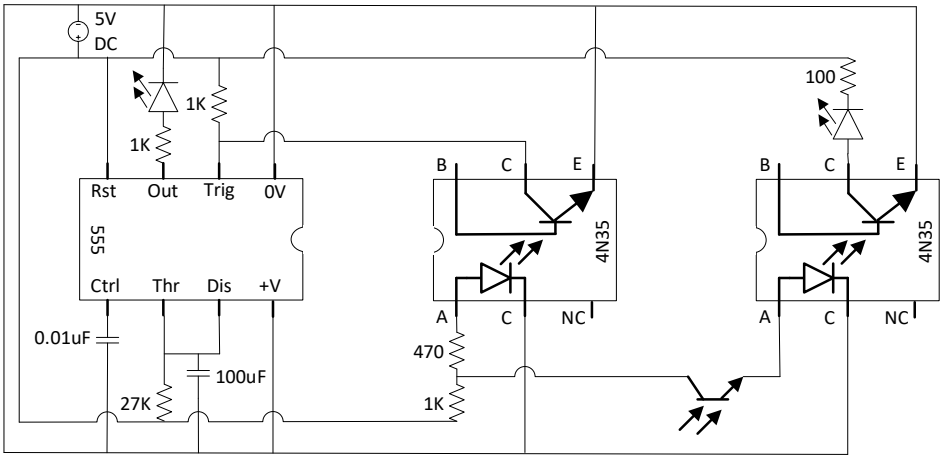
The core components of the detection circuit are:

Vishay TEPT4440 – Ambient Light Sensor

Vishay 4N35 – Optocoupler

Texas Instruments NE555 – Precision Timer

A diagram of the circuit is shown below:



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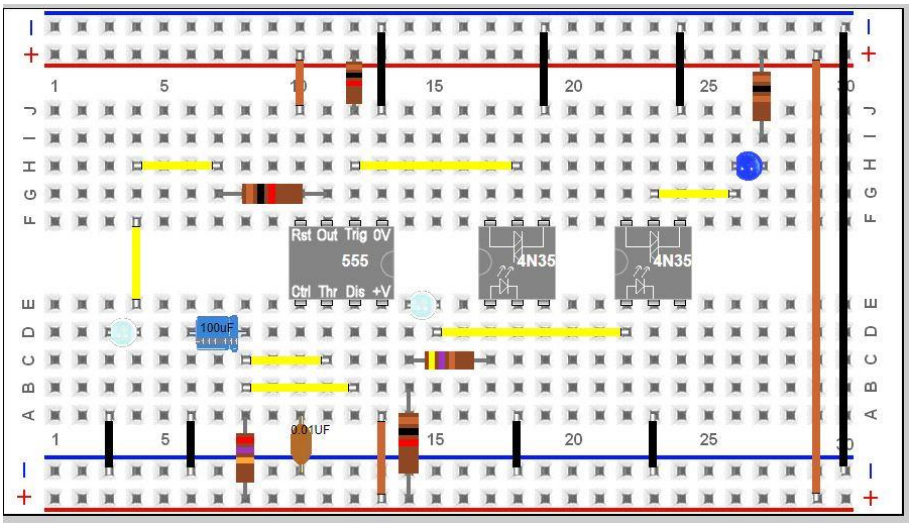
The basis for this design is very straightforward. When the TEPT4440 light sensor in the lower right of the circuit is energized by the photo diode, the flow of electricity is routed to the 4N35 optocoupler on the right and powers the secondary or aiming LED in the upper right. When a baseball or softball interrupts the beam, the circuit to the sensor is temporarily broken and the flow is routed to the 4N35 in the center of the design. This event generates a trigger for the 555 timer on the left of the circuit which powers the primary or indicator LED in the upper left of the circuit diagram. After a few seconds, the 555 timer will reset.

Since my project required only 20 of the circuits, I decided to use the Perma-Proto half-sized breadboards offered by Adafruit. I was very impressed with the quality of these units and the ease of creating the circuits. To layout the circuit on the breadboard, I used the online application, Pebble, that is available at:

https://www.4dsystems.com.au/downloads/pebble/P_for_FF.html

The design for the breadboard is shown in the following Pebble image:



I found the photo diodes on eBay. The specifications are listed below:

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Mini-type 1mW 650nm Red Laser Dot Diode Module w/ Driver 3V 6x10mm	
Wavelength	650nm
Output Power	1mw
Working Voltage	3v
Working Current	<40mA
Focusable	Yes
Working Temperature	-10 ℃~＋40 ℃
Laser Shape	Dot
Material and Color	Metal
Lens	Plastic
Beam Divergency	Φ10-15mm at 15m
Dimensions	6*6*10mm

I ordered a set of 12mm adjustable holders from eBay to mount the photo diodes. I created a sleeve from 12mm OD/6mm ID aluminum tubing to hold the diode and drilled a small hole in the sleeve for a long set screw (see the image below).

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Summary

I was very surprised and pleased how well the cheap photo diodes worked with the circuit. The maximum working distance between the two was much further than I needed. I hope you have as much fun from your projects as I did with this one.