LDR_Light_Switch3 -- Overview

Mukesh Soni
Product Marketing Manager
Basic Scopes Product Line
Tektronix

Tektronix

OBJECTIVES

After performing this lab exercise, learner will be able to:

- Use LDR (Light Dependent Resistor) to detect light intensity variation and detect threshold crossing
- Define threshold dynamically using a potentiometer
- Program Arduino board to:
  - Digitize and capture voltage across LDR
  - Read another analog input to comparision with LDR output
  - Switch a relay / LED connected to a digital output pin
- Use digital oscilloscope to:
  - Trigger on input channel
  - Measure the signal amplitude
  - Work with reference waveforms

EQUIPMENT

To carry out this experiment, you will need:

- TBS1KB-Edu Digital Oscilloscope from Tektronix
- Arduino Duemilanove or Uno board
- Voltage probe (provided with oscilloscope) / BNC cables
- Breadboard and connecting wires
- Simple circuit components – LDR, Resistor 10k & 470 Ohms, LEDs and Potentiometer 100K ohms

THEORY

Key points:

- LDR changes its resistance based on the light intensity incident on it. Higher the light, lower will be resistance and vice versa.
- Change in resistance can be converted in to voltage variation by voltage divider implemented using LDR and a fixed resistor.

$$V_{in} = 5V$$

Voltage Divider Using LDR

$$V_{out} = V_{in} \times \frac{R_{LDR}}{R + R_{LDR}}$$
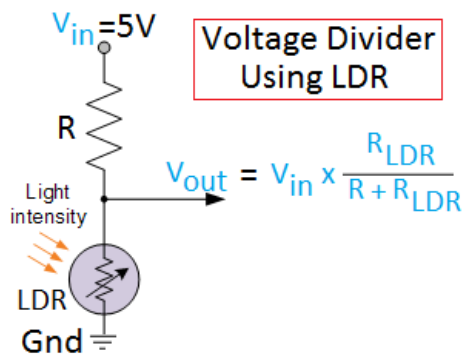
- The voltage across LDR can be measured using oscilloscope or digitized/recorded using Arduino - The voltage is proportional to darkness (%).
- We can dynamically provide 'darkness' threshold (in volts or ADC levels) using another potentiometer for switching. If the LDR output crosses this level, Arduino should turn one of its digital pin ON (High).
- An LED or relay can be used at the digial output pin for indicating switching action.

LDR_Light_Switch3 -- Procedures
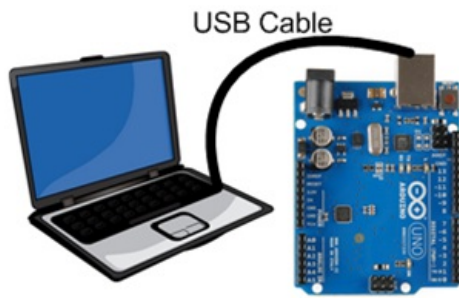
Step 1

DUT Setup: Arduino-LDR Circuit

Prepare the circuit (using LDR, Resistor, Potentiometer, LEDs and Arduino) as shown below:
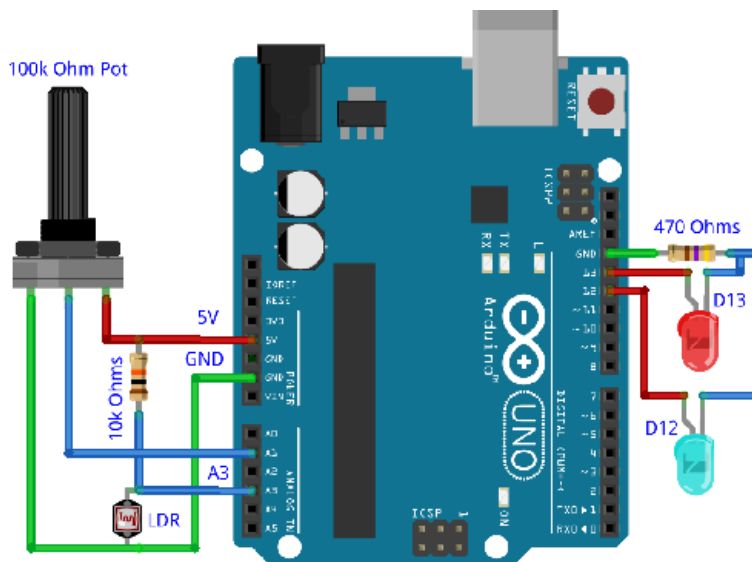
Step 2

DUT Setup: Connecting Arduino with Computer

- Connect the Arduino to computer using USB cable.

USB Cable

- Launch Arduino IDE and ensure correct USB port number and Board name for establishing the connection

Step 3

DUT Setup: Programming Arduino

- Open the code - "Ligh_Switch_3.ino" - in Arduino IDE.
- Compile and upload the program on Arduino board for execution

Step 4

Scope and DUT connection:

- Channel 1 probing at LDR output (pin A3 of Arduino)
- Channel 2 probing at Potentiometer output (pin A1 of Arduino)

Step 5

Scope Settings: Horizontal / Vertical Scale
Do autoset (or manually set) and ensure following settings:

-
- Horizontal scale = 50 ms/div
- Channel 1 & 2:
  - Vertical scale   = 1V/div
  - Vertical position = -3V (-3 divisions)

Step 6

Scope Settings: Measurements
Using 'measure' menu, add following measurements to CH1 and CH2:

- RMS
- Mean

Step 7

Looking at the Mean/RMS value of CH2, vary the potentiometer till it reaches the mean value of 3.5V.

Step 8

Once CH2 reaches 3.5V, save CH2 as Reference Waveform Ref A. Press Save/Recall button from the front panel and do following settings:

- Save/Recall > Action setting = Save Waveform
- Save To = Ref
- Source = Ch2
- To = Ref A
- Press Save

Step 9

Turn on Ref A: You would see white trace (horizontal line @ 3.5V, where CH2 was)

- Press Ref (R) button on front panel
- Ref A = On

Step 10

Now change the probing for CH2 – connect CH2 to Pin D13 (LED output)

Step 11

Scope Settings: Trigger

- Trigger source = CH2,
- Edge = Rising
- Trigger Level = 2.5V

Step 12

- Vary the light incident on LDR (you can use mobile flash light or torch) and acquire signal using Single Acquisition.
- Verify that you LED glows (CH2 goes to 5V) only when CH1 (LDR output) crosses the threshold (Ref A)

Step 13

Now your light controlled switch is ready for use. You can set your light controlled switch –

- Create the darkness level you want to have your LED on for
- Now adjust the potentiometer that it turns the LED off
- Now rotate the pot in other direction slowly till it just switches on the LED
- You've just defined / set the darkness threshold for switching on the LED. If there is more light than this, LED will turn off and vice versa.