LDR_Light_Switch2 -- Overview

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OBJECTIVES

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

- Use LDR (Light Dependent Resistor) to measure the light intensity variation in terms of voltage at the LDR output
- Program Arduino board to:
  - Digitize and capture voltage across LDR
  - Compare it against a fixed threshold and
  - Switch a relay / LED connected to a digital output pin
- Use digital oscilloscope to:
  - Trigger on input channel
  - Measure the signal amplitude
  - Measure delay using cursors

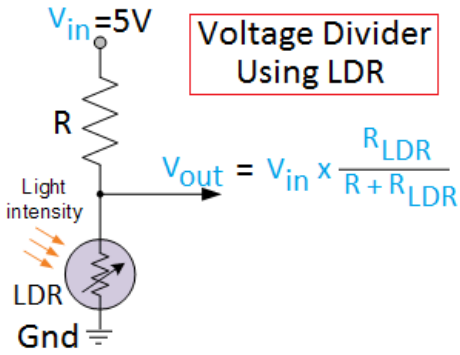
EQUIPMENT

- 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

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.



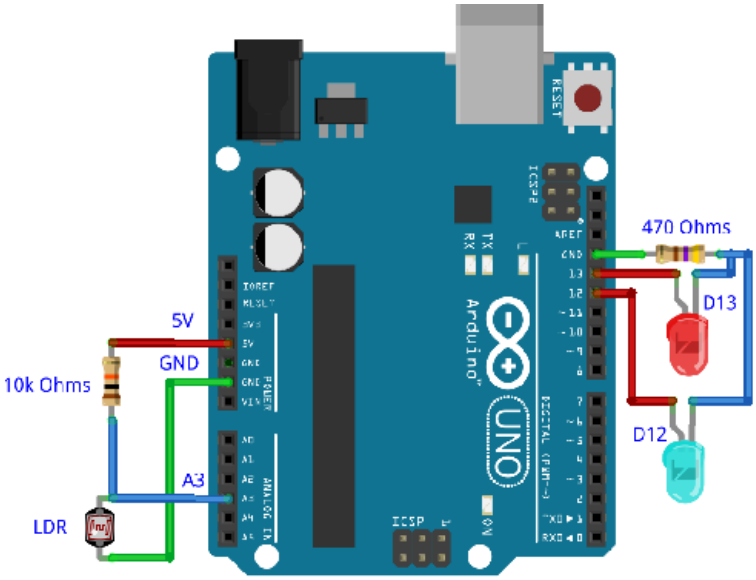
- The voltage across LDR can be measured using oscilloscope or digitized/recorded using Arduino - The voltage is proportional to darkness (%) -
  - ~5V = 100% darkness
  - ~0V = 0% darkness
- We can define a fixed 'darkness' threshold (in volts or ADC levels) for switching. If the LDR output crosses 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_Switch2 -- Procedures

Step 1

DUT Setup: Arduino-LDR Circuit

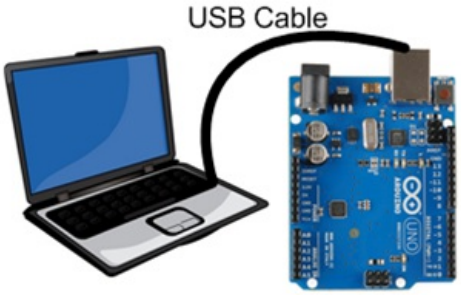
Prepare the circuit (using LDR, Resistor and Arduino) as shown below:



Step 2

DUT Setup: Connecting Arduino with Computer

- Connect the Arduino to computer using USB cable.

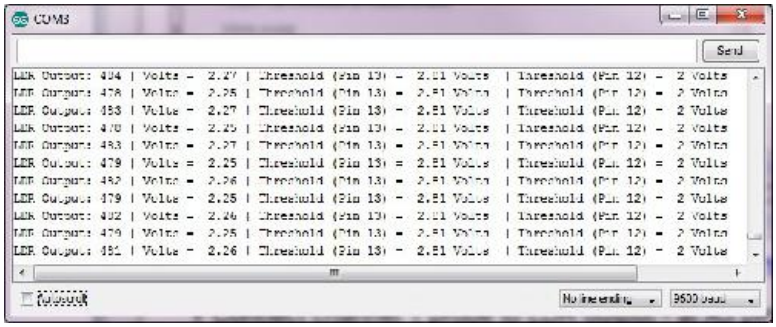


- Launch Arduino IDE and ensure correct USB port number and Board name for establishing the connection.

Step 3

DUT Setup: Programming Arduino

- Program the Arduino board with code - "Ligh_Switch_2.ino"
- Once the program is uploaded and running on Arduino, open serial monitor



- Read the Threshold level for LEDs connected at Pin 12 and Pin 13 of Arduino.

Step 4

Scope and DUT Connection:

- Connect channel 1 probe to LDR output - at A3 pin of Arduino.
- Connect channel 2 probe to pin 13 (digital output) of Arduino

Step 5

Scope Settings: Horizontal / Vertical Scale & Trigger

Do autoset (or manually set) and ensure following settings:

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

- Channel 2:
  - Vertical Scale = 1V/div
  - Vertical Position = -3 div
- Edge Trigger on CH2, Trigger level = 2.5V
- Single Trigger

Step 6

Scope Settings: Measurements

Using 'measure' menu, add following measurements to CH1:

- RMS
- Mean
- Maximum

Step 7

- Press SINGLE from front panel on the scope
- Vary the light condition around LDR till the LED on pin 13 glows -- start with higher light and then reduce it to create darkness.

Step 8

- Verify that when CH1 (LDR output) crosses the threhsold of 2.81V (same as trigger level), the LED on Pin 13 glows and voltage goes to 5V (low to high transition)

Step 9

- Do you see a delay between CH1 (LDR output) crossing the threshold of 2.81V and CH2 (LED on Pin 13) making Low to High transition?
- Using vertical (time) cursors, measure this delay.
- Can you tell why is this delay?

Step 10

- The delay is caused due to 'Serial.Print' code in the program - Serial writing takes sometime and hence causes the delay.
- Next, comment all the serial printing code and re-run the program on Arduino.
- Repeat the steps 7-9.
- Does the delay vanish now?

Step 11

Scope and DUT Connection:

Modify the probing point:

- Connect channel 1 probe to LDR output - at A3 pin of Arduino.
- Connect channel 2 probe to pin 12 (digital output) of Arduino

Step 12

- Verify the switching for another LED connected to Pin12, having a different threshold (2V).
- Again aquire signal (SINGLE acquisition) while you vary the light condition around LDR till LED on pin 12 glows -- start with higher light and then reduce it to create darkness.

Step 13

- You can play around with changing light intensity around LDR and you would see the LED flashing the moment LDR output crosses the threshold. Take a screenshot of it.
- Verify the switching against threshold crossing.