Experiment-4

An Application: Light Sensor

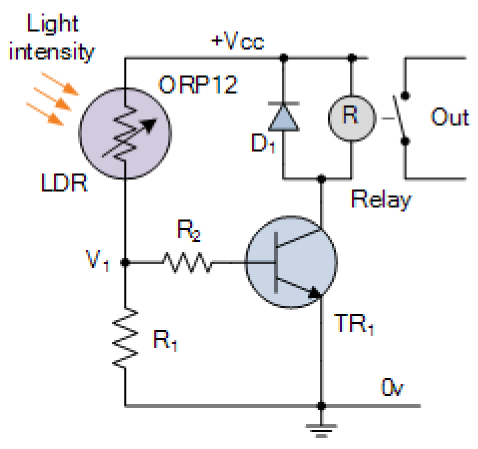
BACKGROUND INFORMATION:

Light sensors are devices that are used to detect light. There are different types of light sensors, each of which works in a slightly different way. They can be found in electronics such as computers and televisions to control the brightness of a television or computer screen.

A light sensor generates an output signal indicating the intensity of light by measuring the radiant energy that exists in a very narrow range of frequencies basically called "light", and which ranges in frequency from "Infrared" to "Visible" up to "Ultraviolet" light spectrum.

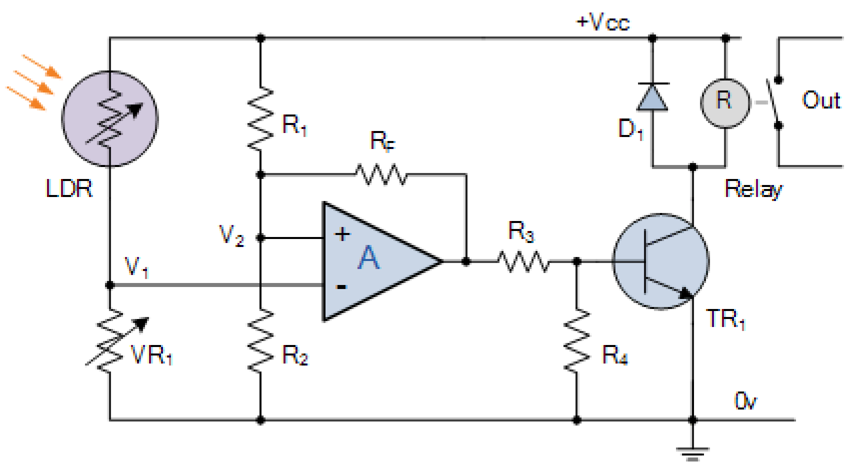
A simple light sensor can be made using a LDR, a photodiode or phototransistor. When the light sensor is exposed to daylight , it outputs an analog value from 0 to 5V or vice versa. The sensor output can not only drive digital level electronics circuits, but also implement to analog circuits.

One simple use of a Light Dependent Resistor, is as a light sensitive switch as shown below.



This basic light sensor circuit is of a relay output light activated switch. A potential divider circuit is formed between the photoresistor, LDR and the resistor R1. When no light is present ie in darkness, the resistance of the LDR is very high in the Megaohms range so zero base bias is applied to the transistor TR1 and the relay is de-energised or "OFF".

As the light level increases the resistance of the LDR starts to decrease causing the base bias voltage at V1 to rise. At some point determined by the potential divider network formed with resistor R1, the base bias voltage is high enough to turn the transistor TR1 "ON" and thus activate the relay which inturn is used to control some external circuitry. As the light level falls back to darkness again the resistance of the LDR increases causing the base voltage of the transistor to decrease, turning the transistor and relay "OFF" at a fixed light level determined again by the potential divider network.



In this basic dark sensing circuit, the light dependent resistor LDR1 and the potentiometer VR1 form one adjustable arm of a simple resistance bridge network, also known commonly as a Wheatstone bridge, while the two fixed resistors R1 and R2 form the other arm. Both sides of the bridge form potential divider networks across the supply voltage whose outputs V1 and V2 are connected to the non-inverting and inverting voltage inputs respectively of the operational amplifier.

The operational amplifier is configured as a Differential Amplifier also known as a voltage comparator with feedback whose output voltage condition is determined by the difference between the two input signals or voltages, V1 and V2. The resistor combination R1 and R2 form a fixed voltage reference at input V2, set by the ratio of the two resistors. The LDR - VR1 combination provides a variable voltage input V1 proportional to the light level being detected by the photoresistor.

As with the previous circuit the output from the operational amplifier is used to control a relay, which is protected by a free wheel diode, D1. When the light level sensed by the LDR and its output voltage falls below the reference voltage set at V2 the output from the op-amp changes state activating the relay and switching the connected load. Likewise as the light level increases the output will switch back turning "OFF" the relay. The hysteresis of the two switching points is set by the feedback resistor Rf can be chosen to give any suitable voltage gain of the amplifier.

The operation of this type of light sensor circuit can also be reversed to switch the relay "ON" when the light level exceeds the reference voltage level and vice versa by reversing the positions of the light sensor LDR and the potentiometer VR1. The potentiometer can be used to "pre-set" the switching point of the differential amplifier to any particular light level making it ideal as a simple light sensor project circuit.

References:

1. www.electronics-tutorials.ws

Experiment-4:

AIM: Make an application on light sensors

EQUIPMENT

Power Supply

Oscilloscope

Voltmeter, Ampermeter, Optical power meter

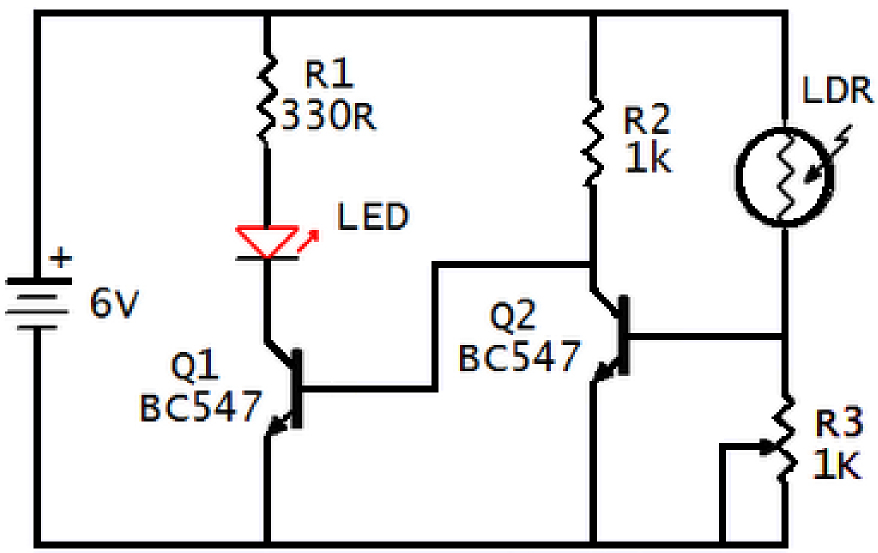
optical

Red led, Photoresistor, Photodiode, Phototransistor

Resistors 1kΩ, 330Ω

PROCEDURE:

1. Build the circuit shown in the figure.



2. When the circuit is powered in the bright medium, see the LED on the circuit. The indicator LED light should go out (turn off). Analyzing the circuits, explain why the LED light went out.

3. Now take an object such as a piece of black paper or cardboard and try to block the light falling on the sensor. See the indicator LED on the circuit. The LED should turn on. Analyzing the circuits, explain why the LED light turned on.

4. Complete the following table by measuring the voltage across resistor of R1 and light power of medium in dark, bright medium and semi-dark mediums.

Sensor type: LDR			
Brightness (intensity)	**Voltage (V)**	**light intensity on the sensor (mW/cm^2)**	**State of the LED (on/off)**
Bright (%100)			
Semi-bright (%75)			
cloudy (%50)			
Semi-dark (%25)			
Dark (%0)			

5. Measure the voltage of LDR sensor. What is the value of this voltage when the LED light passes from ON to OFF or versa vice?

6. Repeat the steps 1-5 of experiment by using other light sensors which are photodiode and phototransistor instead of LDR.

Sensor type: Photodiode			
Brightness (intensity)	**Voltage (V)**	**light intensity on the sensor (mW/cm^2)**	**State of the LED (on/off)**
Bright (%100)			
Semi-bright (%75)			
cloudy (%50)			
Semi-dark (%25)			
Dark (%0)			

Sensor type: Phototransistor			
Brightness (intensity)	**Voltage (V)**	**light intensity on the sensor (mW/cm^2)**	**State of the LED (on/off)**
Bright (%100)			
Semi-bright (%75)			
cloudy (%50)			
Semi-dark (%25)			
Dark (%0)			

7. Comment the all experimental results obtained by LDR, photodiode and phototransistor.