SIERRA COLLEGE	MECH 10 - Lab 10 Light Activated Switch	Mechatronics Real Skills Real Jobs
Name: Cayce Beames Date: October 7, 2019 Professor Steven Gillette		

Abstract
In this lab, I experimented with a light dependent resistor (LDR) and an LM311 comparator integrated circuit to create a buzzer circuit that can sound a buzzer when the LDR is exposed to light, or to silence the buzzer when the LDR is covered and not exposed to light. Additionally, resistance and voltage values were measured in the circuit to help explain more clearly how the behavior of the circuit is made possible.

Learning Objectives

- Apply a light dependent resistor in a light detection circuit
- Apply an analog comparator (the LM311) in a light detection circuit
- Measure electrical values using a digital voltmeter

Notes:

1. Took all voltage measurements relative to ground (unless otherwise stated)
2. Recorded relevant measurements and calculation results in data tables
3. Recorded all measured values on the circuit schematics
4. Used all available precision in calculations, rounded off answers to 3 significant figures

Materials

Quantity	Description
1	Global Specialties Circuit Trainer
1	Digital multimeter (DMM)
	Circuit 1
1	R1 – 2KΩ
1	LDR
	Circuit 2
1	Potentiometer, 10kΩ
1	Comparator, LM311
1	Piezo buzzer

Procedure –Circuit 1

1. ***Measured and recorded*** the resistance value of the light dependent resistor in the full light and in shadow.

Condition	R_{LDR}
Light	1.21kΩ
Dark	9.54kΩ

2. Built Circuit 1

3. ***Measured and recorded*** the divider voltage output for both light and dark conditions

Condition	V_{out}
Light	1.9V
Dark	3.93V

Procedure –Circuit 2

4. Built Circuit 2

5. Adjusted the potentiometer until the beeper just turned off

6. ***Measured and recorded*** comparator input voltages V_1 & V_2 and comparator output voltage V_{out}.

7. Shadowed the LDR. The beeper sounded. ***Measured and recorded*** comparator input voltages V1 & V2 and the comparator output voltage.

	V_1	V_2	V_{out}
Light	1.99V	3.09V	312mV
Dark	4.24V	3.09V	3.59V

8. Reversed the positions of R1 and the LDR. Adjusted the potentiometer until the beeper just turns on.

9. Shadowed the LDR. The beeper turned off.

10. ***Measured and recorded*** – V1, V2 and V_{out} for light and dark conditions.

	V_1	V_2	V_{out}
Light	5.05V	2.62V	3.59V
Dark	4.45V	2.63V	330mV

Critical Thinking

1. What causes Circuit 1 output voltage to increase in reduced light?

As the amount of light exposed to the light dependent resistor (LDR) decreases, the voltage across the output increases because the resistance increases within the LDR.

2. Describe the change in Circuit 2 output function when R1 and the LDR positions are reversed?

When the light dependent resistor (LDR) is at the bottom of circuit 2, and the 2KΩ resistor is at the top of the circuit, as light increases, resistance decreases across the LDR allowing less voltage to be seen at pin 3 of the LM311 comparator. This input voltage at pin 3 is closer to ground potential and farther away from the voltage seen at pin 2, controlled by the potentiometer. Because of this difference the base of the output

transistor stays low and the beeper is quiet, receiving no voltage from the output transistor's emitter.

When the position of the LDR and the 2KΩ resistor are changed, the behavior changes. As light increases at the LDR, the voltage across the 2kΩ resistor increases allowing for the input voltage at pin 3 of the comparator to increase. This increase in voltage then allows the base of the output transistor to reach the threshold voltage to cause the emitter of the output transistor to go high and the beeper sounds.

3. Describe a practical application for an LDR.

A light dependent resistor (LDR) has many practical applications. A common household application is external lighting. As the sun goes down, the light across the LDR decreases to a particular threshold and an external household light is then turned on. I have one of these lights at my house.

Additionally, an LDR can be used in robotics applications where a robot could seek out and home in on a light source.

Conclusions

This lab was an interesting experiment in the behavior of the light dependent resistor (LDR), the behavior of the LM311 comparator as well as a practical application of a voltage divider. As resistance across the LDR decreased, the voltage drop across the component also decreased, forcing the other half of the voltage divider to absorb the majority of the voltage. When connecting to the input pins of the LM311 comparator, this allowed for the control of an output, in this case a buzzer, based on the light allowed into the LDR. The logic could also be reversed so that the buzzer can be either on when light, or on while dark.

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1	R1 – 2KΩ
1	LDR
	Circuit 2
1	Potentiometer, 10kΩ
1	Comparator, LM311
1	Piezo buzzer

Procedure –Circuit 1

1. ***Measure and record*** the resistance value of the light dependent resistor in the full light and in shadow.

Condition	R_{LDR}
Light	1.21kΩ
Dark	9.57kΩ

2. Build Circuit 1
3. ***Measure and record*** the divider voltage output for both light and dark conditions

Condition	V_{out}
Light	1.9V
Dark	3.93V

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Procedure –Circuit 2

4. Build Circuit 2
5. Adjust the potentiometer until the beeper just turns off
6. ***Measure and record*** comparator input voltages V_1 & V_2 and comparator output voltage V_{out}.
7. Shadow the LDR. The beeper should sound. ***Measure and record*** comparator input voltages V1 & V2 and the comparator output voltage.

	V_1	V_2	V_{out}
Light	1.99 ✓	3.09 ✓	312 mV ✓
Dark	4.24 ✓	3.09 ✓	3.59 ✓

8. Reverse the positions of R1 and the LDR. Adjust the potentiometer until the beeper just turns on.
9. Shadow the LDR. The beeper should turn off.
10. ***Measure and record*** – V1, V2 and V_{out} for light and dark conditions.

	V_1	V_2	V_{out}
Light	5.05 ✓	2.62 ✓	3.59 ✓
Dark	4.45 ✓	2.63 ✓	330 mV ✓

Critical Thinking

1. What causes Circuit 1 output voltage to increase in reduced light? resistance increases
2. Describe the change in Circuit 2 output function when R1 and the LDR positions are reversed? resistance relative to ground is opposite
3. Describe a practical application for an LDR. alarm, switch to cause motor to work light following robot.

Grading Criteria

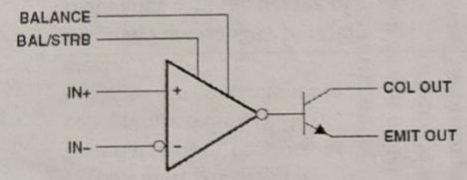
		Points Possible	Points Earned
Documentation	Abstract, introduction, experiment, data results, conclusions, attachments, clarity, spelling, grammar	**10**	
Circuit 1	Resistance values and divider voltage values and recorded in data table	**5**	
Circuit 2	Comparator input and output voltages accurate and recorded in data table	**5**	
	Comparator input and output voltages accurate and recorded in data table (with R1 & LDR reversed)	**5**	
Critical Thinking	Questions answered completely & accurately. State conclusions drawn and lessons learned from the lab	**10**	
On-time submittal	Lab report is submitted in accordance with the assignment due date as posted on Canvas	**5**	
	Total	**40**	

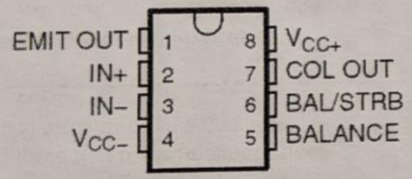
Light Dependent Resistor (LDR)

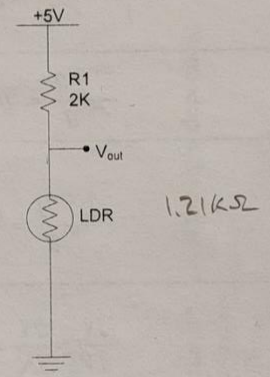
Light dependent resistors will provide variable resistance as a function of light intensity. More intense light reduces resistance. They are made from cadmium-sulfide. In this circuit, the LDR serves as one resistance in a two-resistor voltage divider causing output voltage to increase as light intensity decreases.

LM311 Comparator

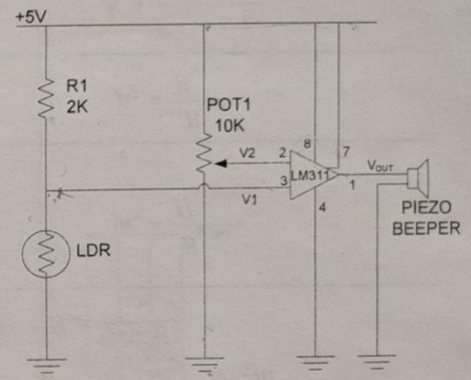
The LM311 comparator output is an NPN transistor connected between pins 1 and 7. In this circuit the output transistor sources current to the piezo buzzer from the collector on pin 7 to the emitter on pin 1. Switching action is driven by a comparison of the pin 2 & 3 voltage values. Output is high when Pin 3 exceeds the Pin 2 reference voltage.







Circuit 1



Circuit 2

SIERRA COLLEGE Mechatronics Real Skills Real Jobs	MECH 10 – FUNDAMENTALS OF ELECTRONICS			
	LAB 10 – LIGHT OPERATED SWITCH			
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JULY 2011	SCALE NONE		SHEET 1 OF 1	

Grading Criteria

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	Total	**40**	

Lab Report Format

Abstract - a summary and high-level overview of the lab and its results
Introduction - State the objectives of the laboratory and list the equipment required
Experiment - Describe the procedure used to carry out the lab
Results Data - list data taken in table or graphical format where appropriate
Critical Thinking - State the conclusions drawn and lessons learned from the laboratory activities. Answer any questions found within the lab procedure.
Attachments – grading criteria, verification signatures, circuit diagrams, lab procedures & notes