**ECEN 214 - 302**

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1. **Description of the Security System**

The components of the security system are: Infrared Emitter, Photo Detector, Current to Voltage Converter, Signal Amplifier, Comparator, SR Latch , and output LEDs. The security system begins with an IR emitter, which sends a continuous signal to a photo detector. The photo detector then has a current induced in it that increases with the intensity of infrared light on it. Then, one can use a resistor to convert the current to a small voltage, which is then sent into an operational amplifier to create a usable voltage. This voltage is used in a comparator, which creates a high voltage whenever the input voltage is larger than the reference voltage. The comparator output is sent to a latch, which will hold a high voltage value (which lights a red LED) until it is reset. If the SR Latch follows it Truth Table the Green LED should light. If the SR Latch output is undefined or no change then the Red LED should light.

1. **Design Choices**

**Emitter**

A 100 ohm resistor was used in the emitter circuit. This is because it is the minimum resistance necessary so that the emitter is not damaged, which means that it causes the emitter to have its maximum voltage across it.

**Current to voltage converter**

An op-amp circuit was used as the current to voltage converter. This is due to the fact that in Lab 4 the op-amp circuit was able to produce a higher voltage that the resistor equivalent circuit given similar parameters.

A 10,000 ohm resistor was used to convert the detector current to a voltage. This is because, if the current is the same, then Ohms Law states that a larger voltage is created from a higher resistance. A higher voltage is creates a bigger range for choosing the reference voltage later.

**Signal amplifier**

An inverting amplifier was used. Since the previous component used an inverting op-amp the voltage need to be inverted back to being positive. This is is need so that a high voltage is produced when the light is unobstructed.

An amplification factor of 1 was desired so that the operational amplifier would invert its input and not amplify the signal as the input signal was near the saturation levels already. To do this two 2000 ohms resistors were used.

**Comparator**

A reference voltage of 3.567 Volts was chosen. The reference was put on the negative terminal of the comparator. This way, the comparator output voltage is high if the input voltage is larger than the reference voltage.

1. **Measurements**

**Task 1**

Voltage after current to voltage converter component:

Current to voltage converter parameters are: Rd = 10,000 ohms

* Unobstructed: -3.711 V
* Obstructed: -0.335 V

Voltage after signal amplifier component:

Signal amplifier parameters are: R1 = 2000 ohms and R2 = 2000 ohms

* Unobstructed: 3.567 V
* Obstructed: 0.357 V

Voltage after comparator component:

Comparator parameters are: R1 = 2200 ohms, R2 = 5100 ohms, and the reference voltage is 3.567 volts.

* Unobstructed: 4.552 V
* Obstructed: 0.011 V

**Task 2**

When the light beam is unobstructed, and one resets the latch, the latch output is 0.006 V.

When the light beam is then obstructed, the latch output becomes 4.972 V.

If the light beam then becomes unobstructed again, the latch output remains high (no change) at 4.973 V.

If one then resets the latch, the latch output becomes 0.007 V.

**Task 3**

Since the SR Latch outputs are the same as the truth table and the latch has been proven to function correctly, to test the LED compare the LED color to the Q outputs from the truth table.

1. **Overall**

Overall, there were not too many issues putting together the circuitry. The only problem was the an emitter and an op amp that were not working originally.Once these parts were replaced the rest of the problems were solved by comparing the circuit to previously drawn schematics and comparing actual circuit measurements to expected circuit values.

1. **Performance**

The circuit works as intended. One should be able to place the emitter and detector 30 centimeters apart and still have the circuit function as intended, as this is the max distance between the two components found in Lab 4. However, since this voltage at this distance was found to be around 0.263 V, the gain of the signal amplifying would have to increase to maintain the same reference voltage of 3.567 V.

I did not experience an false alarms when testing the completed circuit. Since the detector and emitter were very close together other voltage inputs from external lights detected by the photo detector we very small. If they were farther apart and more external ir sources were involved the may have been false alarms and missed detections.

1. **Conclusion**

In conclusion, the purpose of this lab was to design an electronic security system. By building on the different pieces of this system we had previously learned we were able to design and test a full system. In addition to the previous circuit created in Lab 4 we also built and tested a latch circuit, which was then integrated into the system, and shown using LED output displays.