Class:	**EE221L - Circuits II Lab**	Semester:	**Fall 2016**

Points		Document author:	**Reiner Dizon** **Ryan Dunlap**
		Author's email:	**dizonr1@unlv.nevada.edu** **dunlar1@unlv.nevada.edu**
		Document topic:	**Final Project**

Instructor's comments:

Goal

The goal of this project is to implement our idea of a police siren with lights. We utilized three NE555 timer chips, a 4017 decade counter chip, and different value resistors and capacitors as the main components for our project. These components are grouped in two different circuits which is meant to operate the siren and the lights separately. Essentially, we had two different circuits (sirens and lights) running in parallel with two different voltage sources. All of these components plus wires are all connected in a breadboard. With this, we are able to implement our circuit in a more organized fashion and ensures proper operation.

Background Theory

The main component of this project is the NE555 timer chip. Inside the chip, there are several elements and devices which enables the timer chip to output signals at given time intervals based on what is connected to the pins of the chips. The chip contains three resistors, two comparators, a flip-flop, and an output stage. All three resistors within the chip have a resistance of 5 kiloohms, hence the name "555" for the chip. These resistors make up a voltage division circuit which outputs both 2/3 and 1/3 of the input voltage which used for the comparator. The comparator checks an input voltage against a given reference voltage using several transistors. The sixth pin is used to compare against 2/3 of input voltage while the second pin is compared against 1/3 of input voltage. The flip flop ensures that the output voltage are only two discrete states, high or low based on the output from the comparator. Two of these timer chips are used for the siren circuit, and one is for the lights' circuit. The other chip used for this project is the 4017 decade counter chip, which is only used for the lights' circuit. Like the timer chips, this counter contains flip-flops, in fact four of them are used. This number of D flip-flops are needed for counting from 1 to 10 in binary which are the output pins of this chip. Inputs to this chip are clock, enable, and reset. The clock control uses an AND gate which takes in the clock and enable inputs. This chip will be used in conjunction with a timer chip to get the lights flashing in a sporadic fashion like a real police light.

Group Member Roles

We had similar roles throughout the entire process of the project. We both brainstormed and researched for ideas that we could do for the project and settled with this project idea. We both were involved in wiring up the circuits where Ryan did most of the wiring and Reiner did most of the checking of the circuitry and rewiring. With these roles, we are able to effectively implement

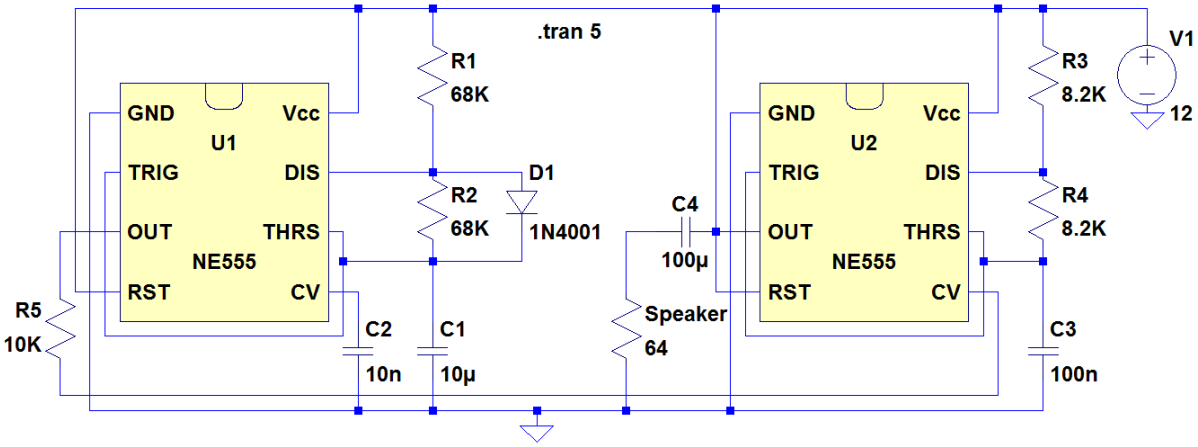
our circuit with minimal issues as the division of labor enables this efficiency. In terms of presenting the project, Reiner's role was writing the final project report while Ryan's role was creating the PowerPoint presentation for the final project.

Schematics/Diagrams

Police Siren Circuit

For the police siren circuit, we used two 555 timers as the main part of the design. The input to the entire circuit is 12 V DC, shown in the far right of the schematic below. The RST and Vcc pins (4 & 8) of the both timers are connected to input voltage. The TRIG and DIS pins (2 & 6) of both timers are connected to each other which is connected to the different valued resistors (68K for the 1st timer and 8.2K for the 2nd timer). Both GND pins (pin 1) are connected directly to ground. Right next to the 1st timer, a 68K resistor is connected in series to another 68K resistor and a 10 microfarad capacitor. The DIS and THRS pins of the 1st timer are connected the ends of the second 68K resistor which is in parallel with a 1N4001 diode. The OUT pin (3) of the 1st timer is connected to the CV pin of the 2nd timer with a 10K resistor in series. The CV pin (5) of the 1st timer is connected to ground with a 10 nanofarad capacitor in series. Similarly, there is two resistors (8.2K) and a capacitor (100n) in series right next to the 2nd timer. Also, the DIS and THRS pins of the 2nd timer are connected to the second resistor. The OUT pin (3) of the 2nd timer is connected to a 64 ohm, 500 mW speaker with 100 microfarad capacitor in series.

Schematic



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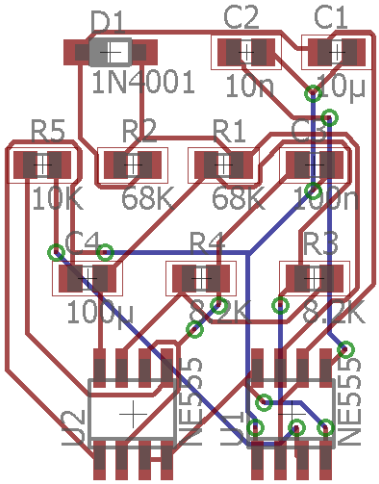
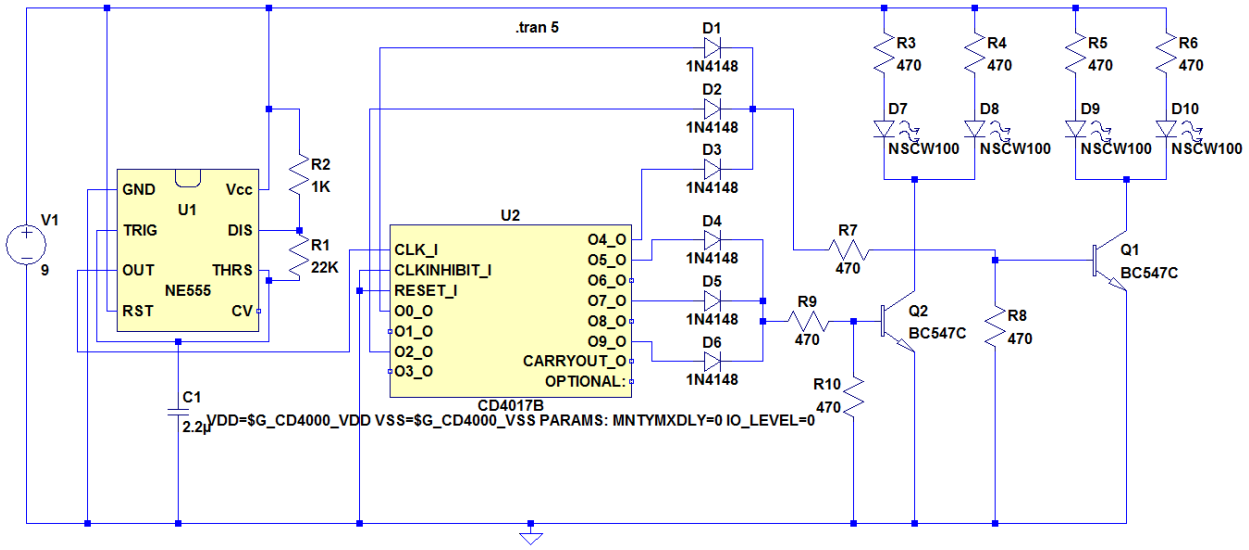


Police Lights Circuit

For the police lights circuit, we used a 555 timer and a 4017 decade counter as primary components of this circuit. The input voltage for this circuit is 9 V DC. The GND, RST, and Vcc pins (1, 4, & 8) are connected in the same manner as the timers in the police siren circuit. A 1K resistor is connected in series to a 22K resistor. At both ends of the 22K resistor, the pins DIS and THRS are connected to them. The OUT pin is connected to the CLK input of the counter chip. Two pairs of two different colored LED (red and green) are connected to the 9V DC input with is in series with 470 ohm resistors. The outputs for 0, 2, and 4 are connected to separate 1N4148 diode which shares a common nod that connects to a voltage divider circuit with two 470 ohm resistors. The base input of the BC547 transistor is output of the divider circuit while the emitter goes to ground and the collector is connected to the negative end of the two LEDs that shares a same node. Similarly, the outputs for 5, 7, and 9 are connected in the same manner.

Schematic



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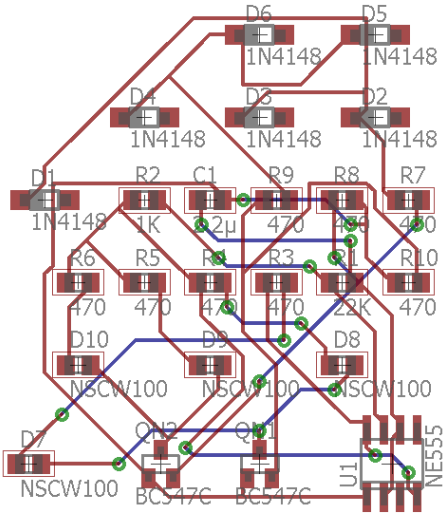
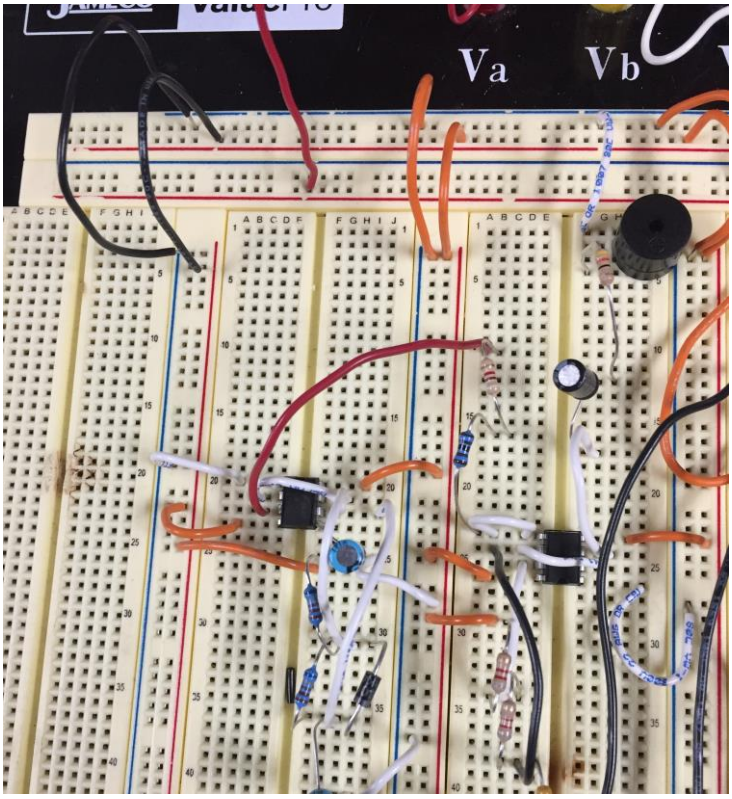


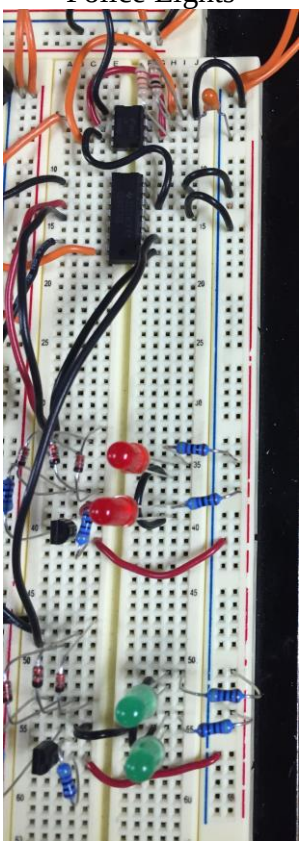
Circuit Operations

The main operations of these circuits are to produce a siren for the speaker and flashing effect for the LEDs. The siren produced sounds like a police siren with its characteristic rhythm. The flashing effect for the LED is a quick switching between the two sets of different colored LEDs These operations happen as soon as power is supplied to these circuits. To turn off the sound and the light at the same time, both power supply must be shut off. However, one of these circuits can be shut off by turning off the supply for that circuit. Pictures of the circuits are shown separately as well as together, including the flashing effect of the LED.

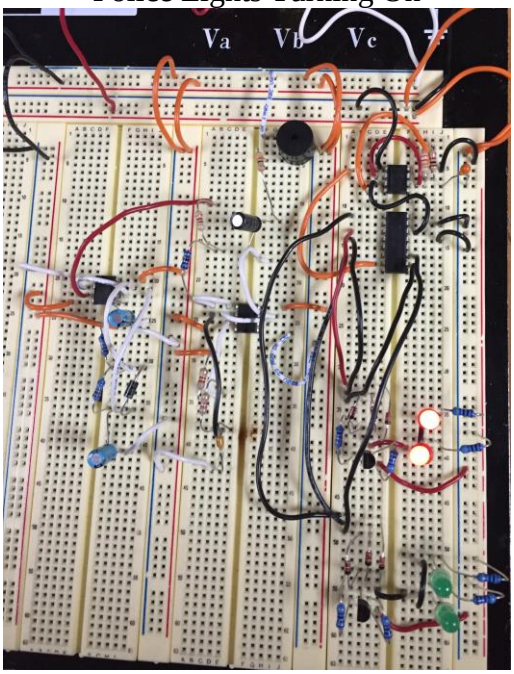
Police Siren



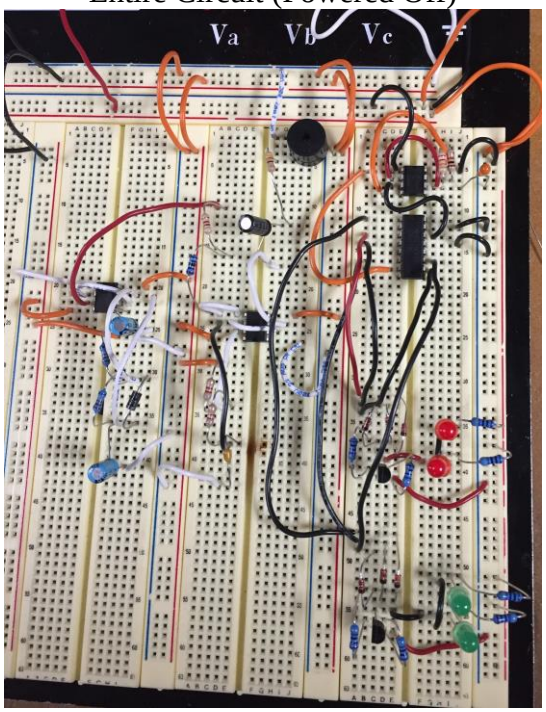
Police Lights



Police Lights Turning On



Entire Circuit (Powered Off)



Encountered Problems

After we implemented the police siren circuit, we wanted to complement it with a police lights which we wanted to be connected to the siren circuit. The first problem that we encountered is that the LEDs were static in first approach of the lights circuit. In order to solve this issue, we created an entirely new circuit that will run in parallel of the siren circuit by implementing a counter with a 555 timer. The next issue that we encountered is the slow alternation between the two sets of LEDs which is not characteristic of a police siren. We resolved this problem by lowering the capacitor value that is connected to THRS and TRIG pins of the NE555 timer. Since these two circuits require two different input voltages, we divided our breadboard to accommodate the two circuits as well as use different connections to power and ground for each power supply.

Conclusions

As a result of working on this final project for this laboratory class, we now have a better understanding of the inner workings of the NE555 timer chip that we previously had not learned in the previous laboratories. For the price of the NE555 timer chip, the capabilities are endless, which is also why it is one of the most used and sold integrated chips in today's world. We have learned the important aspects of the NE555 timer, including the many mode operations it is capable of producing: monostable, astable, and bistable. These different operating modes open up limitless opportunities for implementing electrical circuits that require simple pulse or oscillation inputs. In this final project we experimented mostly with an astable operating manner that produced a high frequency single and two-tone continuous square wave output for both our police lights and siren. Also, we learned how to wire up multiple active circuit devices, such as the timer and counter chips, in different applications. Overall, the NE555 timer project has been an excellent learning experience and a good introduction to the process of building electrical circuits.