EE 320L, Section 1004

Final Project: Decorative LED Array

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Abstract: This project is intended to produce a decorative LED array which blinks intermittently using a 555 timer and a 16 pin decade counter along with an assortment of of resistors, capacitors, diodes and transistors. The process of building this circuit includes applying soldering pasted to the PCB and placing the components in their respective places as per the circuit design. After placing the components the PCB is placed in an infrared oven and baked to melt the solder paste to the board and the components. Testing the circuit involves connecting a voltage source for which a pair of AA batteries in series is used, and observing the LED's to ensure every LED is functioning and lighting up in sequence.

Equipment Used:

Table 1: Component Values Description

Reference	Description	Value	Marking
C1-C12	0805 SMD capacitor	various	brown
C13-C26	0603 SMD capacitor	various	brown
C27, C28	0805 SMD capacitor	0.1 uF	brown
D1	0805 SMD LED	red	0805 SMD LED pin IC
D2-D11	0805 SMD LED	red	0805 SMD LED pin IC
D12-D15	Ziener diode LL34	1N4148	red cylinder
D16-D19	0805 SMD LED	blue	0805 SMD LED pin IC
R1-R12	1206 SMD resistor	various	-
R13-R24	0805 SMD resistor	various	-
R34-R47	0603 SMD resistor	various	-
R48	0805 SMD resistor	10K ohm	103
R49	0805 SMD resistor	2M ohm	205
R50-R60	0805 SMD resistor	330 - 470 ohm	331
R61-64	0805 SMD resistor	10K ohm	103
R65-R68	0805 SMD resistor	330 - 470 ohm	331
Q1-Q4	SOT23 NPN transistor	S8050	J3Y
U1	NE555 timer SOP8	NE555	8 pin IC
U2	Decade Counter SOP16	CD4017	16 pin IC

Completed circuit:

The completed circuit when connected to power is using the 555 timer in conjunction with the decade counter chip to run a program of sorts which is designed to light all of the LEDs periodically and in sequence. The circuit has an assortment of LEDs arranged in a circle which light up individually in sequence. In addition to this there is a single LED in the middle of the circle which blinks at a faster rate, and four LEDs one in each corner of the PCB which blink in unison at a slower rate.

The transistors in this circuit are used to close the switch between each of the four corner resistor's negative terminal and ground. This completes the circuit and turns the LEDs on periodically as the base nodes of the transistors are all connected to the CO (carry out, pin 12) pin of the decade counter.

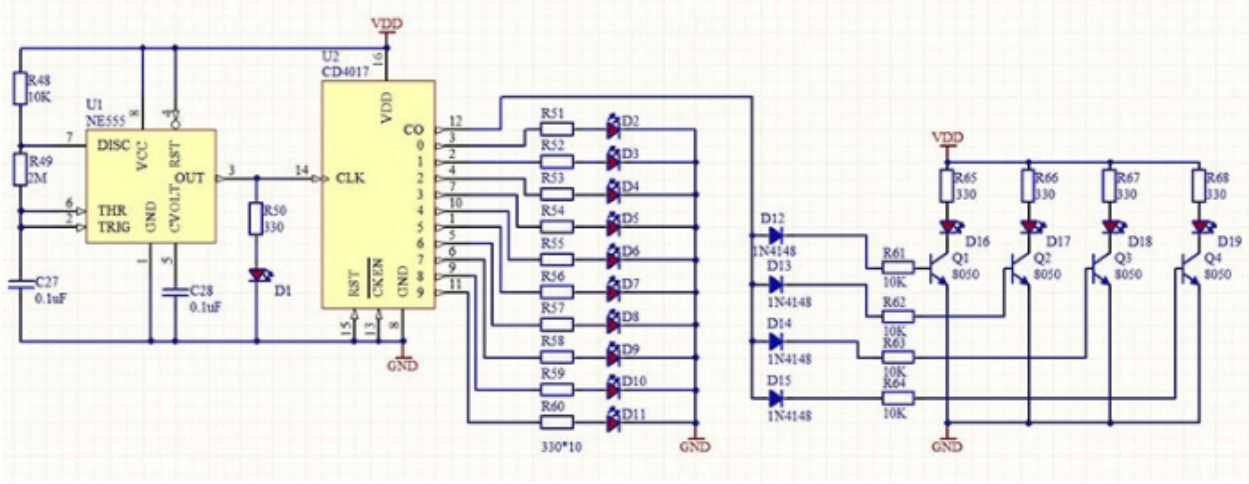

Figure 1: Circuit diagram

The physical circuit's timer cycle can be measured using an oscilloscope as D1 is connected directly to the output of the timer. It has a frequency of 6.29 Hz. Compared to the values from the given link https://ohmslawcalculator.com/555-astable-calculator using C = 0.1 microFarads, R1 = 10 kilo ohms and R2 = 2 mega ohms the experimental values are slightly different. The calculated values give a frequency of 3.599 Hz and a period of 277.893 milliseconds. This error can be attributed to the fact that all components in the circuit have at least a +-5% tolerance.

This circuit uses the decade counters various output pins to incrementally turn on the D2 through D11 LEDs in a circular pattern. As the decade counter increments from the 0 through 9 pins the LEDs are turned on in sequence.

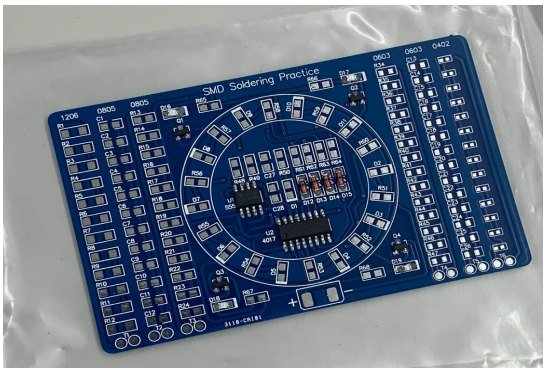

Figure 2: Adding components with soldering paste

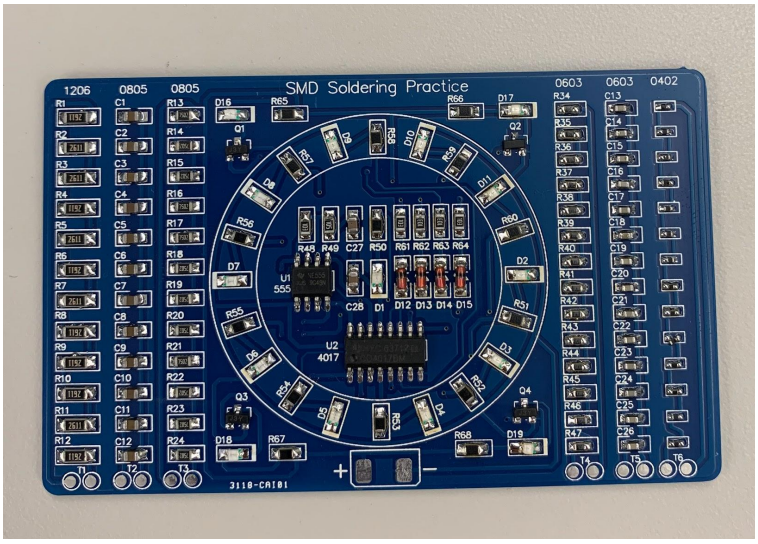

Figure 3: After baking in infrared oven

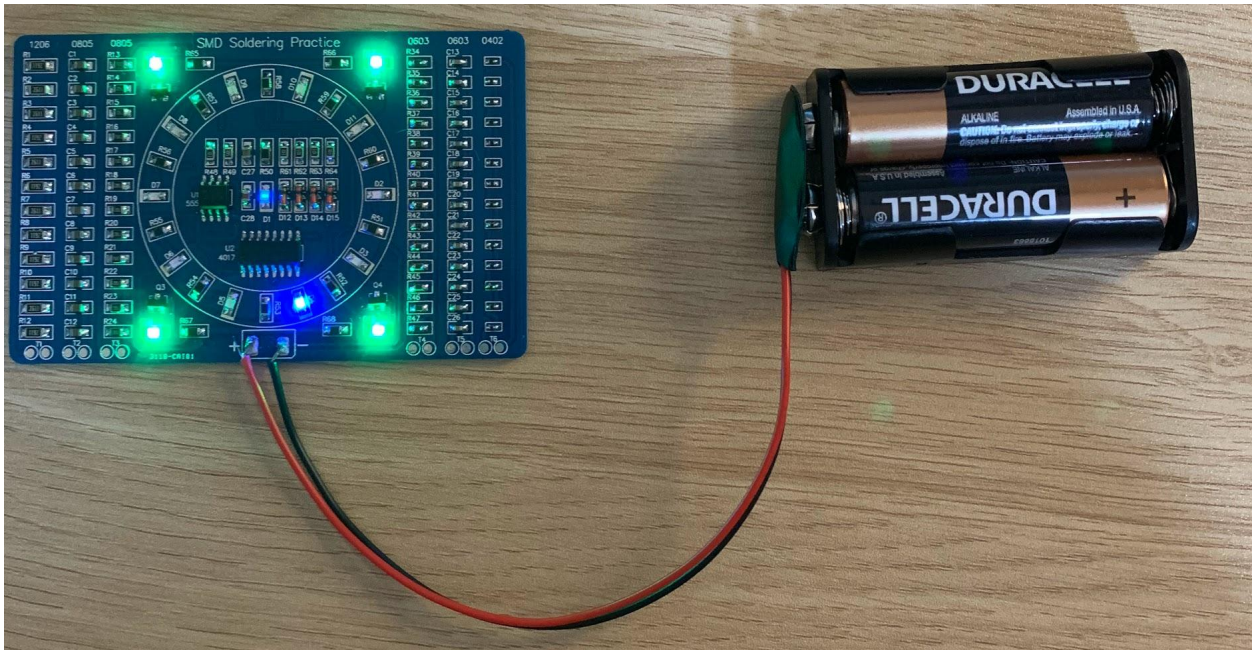

Figure 4: Completed circuit with power applied

Figure 5: Oscilloscope measurement of timer output