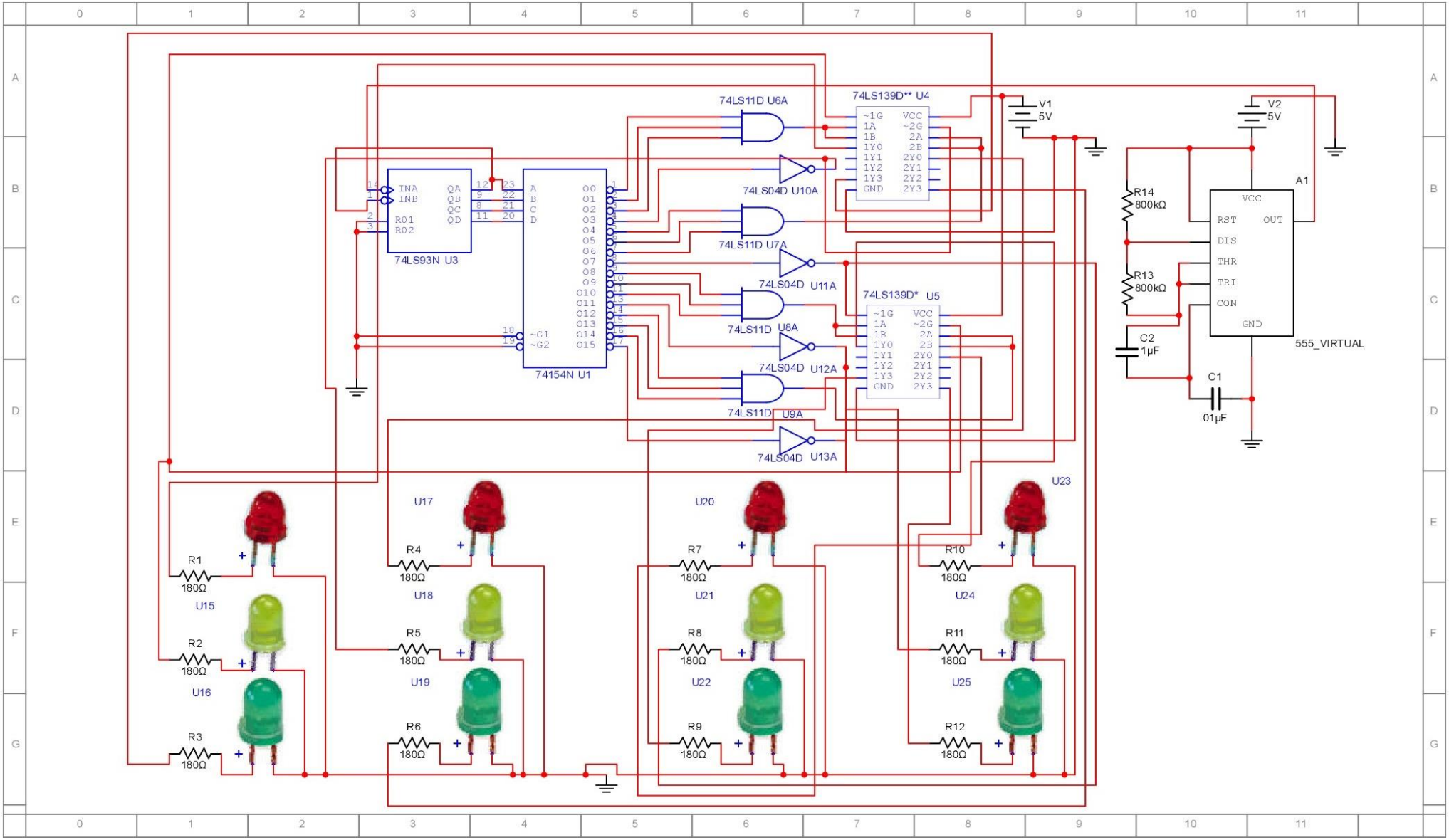
Traffic Light Circuit

AIM – To design a synchronous circuit for regulating traffic in a 4 way road junction with traffic ON time of 5s and transition time of 1s.

COMPONENTS REQUIRED

- 555 (Timer)
- 7493 (4 bit Ripple Counter)
- 74154 (4x16 Decoder)
- 7411 (3 bit AND)
- 7404 (NOT)
- 74139 (Dual 2x4 De-Mux)
- Resistors (180Ωx12, 800kΩx2)
- Capacitors (1μF, 0.01μF)
- LEDs (Red, Green and Yellow)
- Component Development System (x2)
- Patch cords (as required)
- Connecting wires (as required)



CIRCUIT DIAGRAM

WORKING

The circuit is primarily controlled by the Timer circuit. The Timer circuit generates the square pulse which acts as the trigger for the Counter. The time period of the pulse is calculated by: $T = 0.693 (R_1 + 2R_2) C$. The total time is dependent on the number of pins of the decoder we are using for the Green Led to be ON. Here we have taken 4 pins of the Decoder for one way selection in which one is for the Transition. So for making the Green Led to be ON for 5 sec, each pin should be selected or the difference between the 2 counts is 1.67 sec. Thus, fixing the capacitor value to 1µF, $R_1=R_2$ came to be around 800kΩ. Now, the output of the timer is connected to the input of the Counter.

The Counter Circuit just counts (in binary) with each of the negative-edge of the pulse from 0 to 15 and accordingly gives binary output to the selection pins of the Decoder for selecting the corresponding output line. The Decoder gives a low output for the selected pin while rest all is high. The output pins of the decoder are used in sets of 3+1. There are 4 such sets for all the 16 pins. The first 3 pins of the set are connected to AND gate which are then connected to De-mux for the selection of the Green or Red Led. The 4^{th} pin of each set is logically inverted.

The input pins of the De-mux are shorted so as to use it as 1x2 De-mux (i.e. either 00 or 11 combination). The De-mux only works if the Enable is LOW and so it is connected with the last pin (after inversion) of the preceding set for the transition to occur. In the current set (let's say S1), during counting output of the AND gate remains 0 for 3 counts (for 3 x 1.67 = 5s). This makes the select pins of the De-mux 00 .Meanwhile all pins including the 4^{th} pin, are high for the preceding set (S4), the 4^{th} pin after inversion its output is 0 which enables the De-mux and the green led is selected to glow for a particular set. After the 3^{rd} count the output of the AND gate changes from 0 to 1 changing the select from 00 to 11 thus the red led is selected to glow (enable being still active). Meanwhile the 4^{th} pin of the current set goes to 0 during 4^{th} count, after inversion its output is 1, this 1 disables the De-mux of the next set (S2 - which was selected for red) simultaneously providing power to the yellow led for S2, thus completing the transition from green to red for S1, and red to yellow (for 1.67s) for the S2. After the 4^{th} count the De-mux for S2 is re-enabled, power to yellow goes off for S2 and green is selected in the same way for S2 as for S1. This pattern repeats for all the 4 sets for the 4 way traffic system.

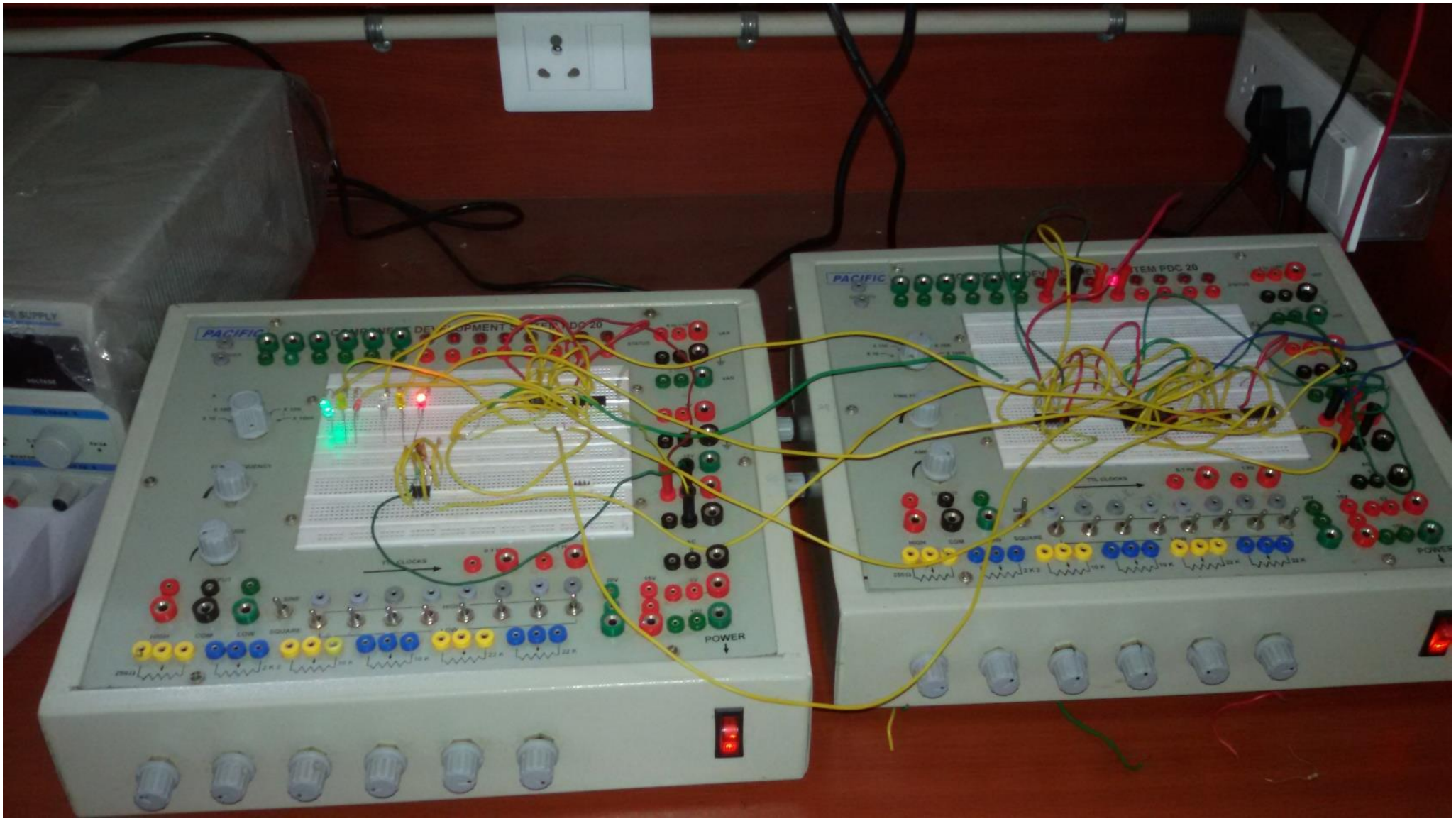


IMAGE OF THE DEMONSTRATED CIRCUIT

POWER CONSUMPTION & COST

- 555 (Timer) – 30mW, ₹ 8
- 7493 (4 bit Ripple Counter) – 40mW, ₹ 20
- 74154 (4x16 Decoder) – 170mW, ₹ 56
- 7411 (3 bit AND) – 20mW, ₹ 15
- 7404 (NOT) – 500mW, ₹ 15
- 74139 (De-mux) – 30mW, ₹ 30
- LEDs (4 glow at an instant) – 120mW, ₹ 12
- Resistors (4 dissipate power at an instant) – 130mW, ₹ 5
- Capacitors - 0W, ₹ 5

Total power = 1.14W **Total Cost = ₹ 166**

CONCLUSION

The traffic light system for a 4 way road junction was designed and successfully run with ON time of 5s and transition time of 1.67s, power consumption of 1.14W and cost of ₹ 166.

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