Digital Logic Design

Project Report

Group 4:

- Asad Virani, 22787
- Danish Badar Qureshi, 22890

Project Title: Road Traffic Signal System

Introduction & Idea:

The main idea of our project is the build and implement the behaviour of a 4-way traffic signal. Our circuit will house 4 different traffic signals, each built with a red and a green LED. Each signal can have two statuses i.e. GREEN/ON/1 and RED/OFF/0.

Red	Green	Signal State
0	1	1
1	0	0

The signals would be divided in such a way that two signals on opposite sides would be paired together (i.e, two pairs of two opposite signals) and would therefore be in sync. The pairs would be switched ON and OFF, alternately after a fixed time interval. The final circuit would work in the following manner (signal 1 and 2 are paired, and signal 3 and 4 are paired):

	Status 1
Signal 1	1
Signal 2	1
Signal 3	0
Signal 4	0

	Status 2
Signal 1	0
Signal 2	0
Signal 3	1
Signal 4	1

Components:

1. 4017 IC
2. 555 Timer IC
3. 4 Red LEDs
4. 4 Green LEDs
5. 1 Yellow LED (for counter pulses)
6. Resistors: 3 x 100kΩ, 13 x 1kΩ, 2 x 470Ω
7. 12 x Diodes
8. 1 x 10F Capacitor
9. Jumper Wires
10. 9V DC Battery

Implementation and Working:

Out project is divided into two main sections:

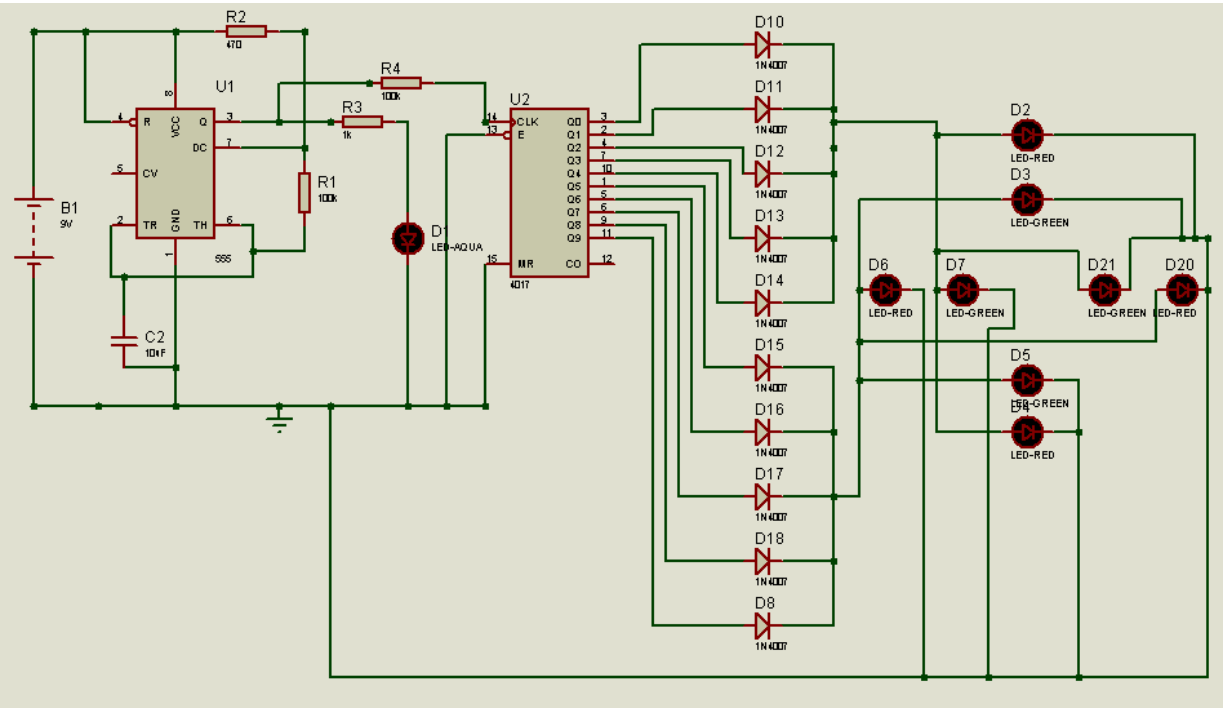
1. Clock
2. Counter

The clock is made using the 555 timer IC. It generates a pulse every 1 second using a resistor of 100kΩ. The pulse frequency is inversely proportional to this resistance, which means it can be increased or decreased by altering the resistance.

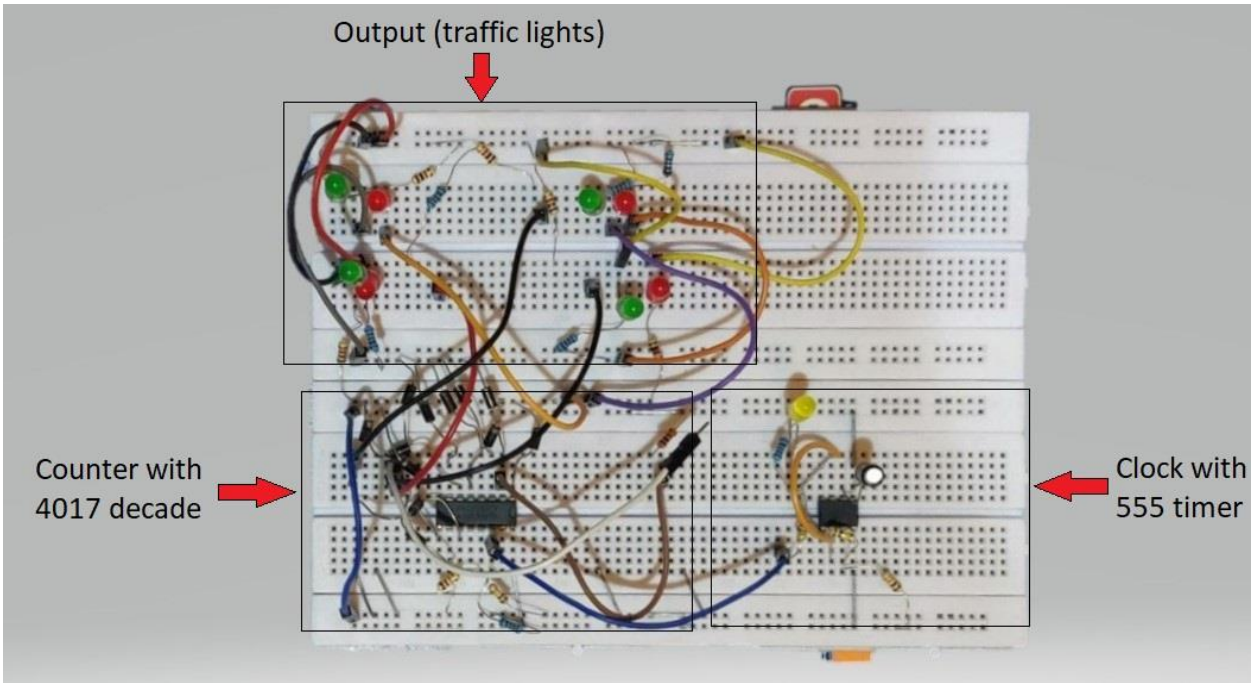
The counter is made using the 4017 IC (decade counter). Its clock input is connected with the 555 timer pulse. After every pulse, the outputs moves to the next i.e. from Q_0 to Q_1 to Q_2, until Q_9. The outputs from the decade counter can then be connected via diodes to the corresponding LEDs of the traffic signal.

As mentioned above there are two pairs of traffic signals. To control these two pairs, the first five outputs are combined together in parallel using diodes; the latter five are also combined similarly. Then, each of the two combinations are connected independently with the two pairs of the signals. This allows each pair to be ON and OFF alternately after every 5 seconds.

Schematic:



Hardware Implementation:



Variations:

1. The two combinations of outputs can be connected using an OR gate instead of a parallel combination.
2. An amber/yellow light can be added for each signal by connecting four of it (two for each pair of signals) with Q_4 for the first pair, and Q_9 for the second pair, so it turns on just before the signal changes.
3. The ON duration of each pair of signals can be altered by connecting the output Q_1, Q_2, until Q_9 in different combinations, for example, if the first eight are combined together and the last two are combined separately, then one pair would be ON for 8 seconds, and the other for 2 seconds.
4. Each pair can also be turned ON for the whole durations of the 4017 IC's counts by connecting it with a toggle flip flop, where output from the flip flop (1 and 0) can then be used to turn each pair ON alternately.

Applications and Conclusions:

The project has immense applications in the real-world. Firstly, a traffic junction is affectively controlled using this kind of automated system. Additionally, a similar circuit with some variations can be used in places where time distribution is important, like a video game where each player gets a fixed time duration to make a move.

Working on this project was very useful in polishing our practical knowledge about the subject. Theoretically we learnt about different combinational and sequential circuits, but by implementing

and working on them hands-on, we were able to increase our understanding. We often faced issues with hardware applications which were resolved by learning about the components in detail and understanding how each value affects the outputs. This way we were also able to learn beyond the syllabus.