CCE242

Electronic Circuits 2

TRAFFIC LIGHT

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Introduction

Traffic lights are crucial for keeping intersections organized and safe. While they may seem straightforward, they rely on complex electronics. This report examines a basic traffic light system that uses two important components: the 555 timer and the 4017-decade counter. By understanding how these parts cooperate, we'll discover how traffic flow is managed effectively.

Theory Of Operation

IC 555

- Pin 4 & 8: These pins are connected to the power supply (battery) to provide voltage to the IC.
- Pin 2 (Trigger): Connected to a capacitor, pin 2 initiates the monostable operation of the 555 timer, determining the duration of the output pulse.
- Pin 6 (Threshold): Linked to pin 2 and the capacitor, pin 6 functions as a switch within the 555 timer. It charges the capacitor until the voltage reaches two-thirds of Vcc (Threshold), triggering the discharge phase.
- Pin 7 (Discharge): Connected to a potentiometer, pins 6 & 2, and the capacitor, pin 7 controls the charging speed of the capacitor, thereby influencing the timing of the LED illumination.
- Pin 3 (Output): Directly connected to the clock input of the 4017 IC, pin 3 provides the clock signal, enabling asynchronous operation of the circuit.
- Pin 4 (Reset): Active low, pin 4 resets the 555 timer when grounded. In this circuit, it remains connected to the power supply to disable the reset function.
- Pin 5 (Control Voltage - CV): Not utilized, as CV typically adjusts the voltage level at pins 6 and 2, which isn't necessary for this configuration.

IC 4017

- Pin 13 (Enable) & Pin 15 (Reset): Both pins are typically used to enable/disable counting and reset the counter, respectively. In this circuit, pin 15 is grounded to enable reset functionality.
- Pin 1 (Clock - CLK): Receives the clock signal from pin 3 of the 555 timer, initiating counting in the 4017 IC.
- Pin 2 (Carry Out - CO): Unused in this configuration but can be utilized to cascade multiple counters.
- Outputs Q0 to Q9: Control the sequencing of the LEDs. Each output is connected to diodes that direct the current to specific LEDs based on the clock cycle, ensuring the desired illumination sequence.
- Behaviour on Rising Edges:
    - With every rising edge (transition from low to high), one output of the 4017-decade counter IC becomes high while the rest remain low. This high output sequentially advances from Q0 to Q9 with each rising clock edge.
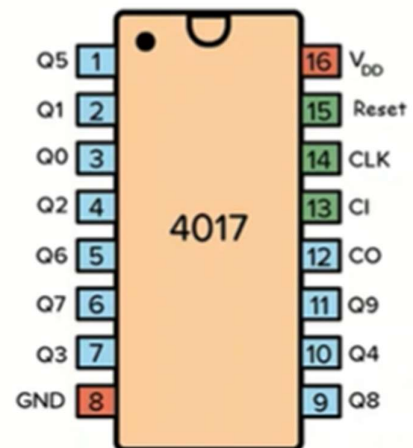
- 4017 Decade Counter Configuration:
    - The 4017-decade counter IC operates with a 5–15-volt supply voltage.
    - A clock signal with a frequency of 5 MHz is applied to the clock input (pin 14).
    - The outputs of the 4017 IC, denoted as Q0 to Q9, transition from low to high sequentially with each rising edge of the clock signal.
    - Each output remains high for the duration of one clock cycle, then returns low until the next rising edge.
- Voltage Levels:
    - At 2.5 volts, the output is considered low.
    - At 5 volts, the output transitions from low to high (rising edge).
    - At 5.5 volts, the output remains high.
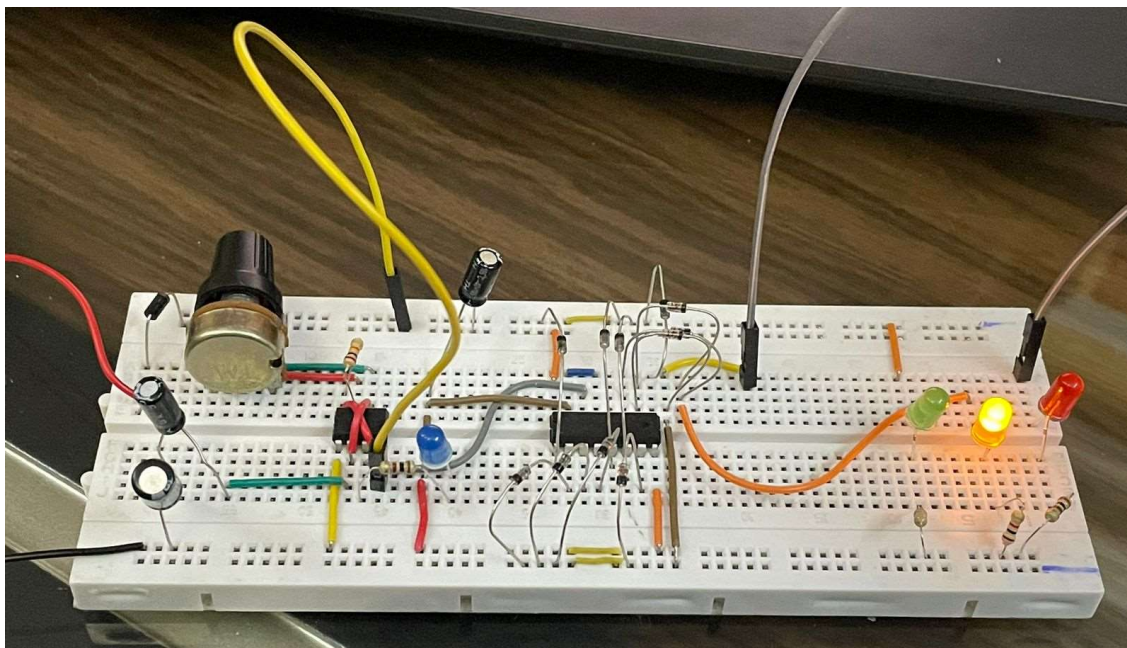
LEDs & Diodes

- **LED Arrangement:**
    1. Red LEDs (Q0 to Q3): Each output from Q0 to Q3 of the 4017-decade counter IC is connected through four diodes to individual red LEDs. This configuration ensures that each red LED remains illuminated for four clock cycles, effectively indicating the stop signal.
    2. Red and Yellow LEDs (Q4): Output Q4 of the 4017 IC is connected to one diode for a red LED and another diode for a yellow LED. This arrangement allows both the red and yellow LEDs to illuminate simultaneously for one clock cycle, indicating both the stop and caution signals concurrently.
    3. Green LEDs (Q5 to Q8): Each output from Q5 to Q8 of the 4017-decade counter IC is connected through four diodes to individual green LEDs. This configuration ensures that each green LED remains illuminated for four clock cycles, effectively indicating the go signal.
    4. Yellow LED (Q9): Output Q9 of the 4017 IC is connected to a single diode, which in turn connects to a yellow LED. This setup ensures that the yellow LED illuminates for one clock cycle, indicating the caution signal.

- **Clock Cycle Duration for Each LED:**
    1. Red LED: Illuminates for four clock cycles, indicating the stop signal.
    2. Red and Yellow LEDs (Both at the same time): Both LEDs illuminate concurrently for one clock cycle, indicating both the stop and caution signals.
    3. Green LED: Illuminates for four clock cycles, indicating the go signal.
    4. Yellow LED: Illuminates for one clock cycle, indicating the caution signal.

- **The diodes serve multiple functions:**
    1. Isolation: Ensures each LED illuminates independently based on the output from the 4017 IC.
    2. Voltage Protection: Prevents damage to the IC by allowing current flow in the correct direction.
    3. Current Limiting: Controls the amount of current flowing through each LED to prevent.
    4. Directional Control: Directs current flow from the 4017 outputs to the corresponding LEDs, ensuring proper illumination sequencing.

Practical work

Schematics Design in proteus
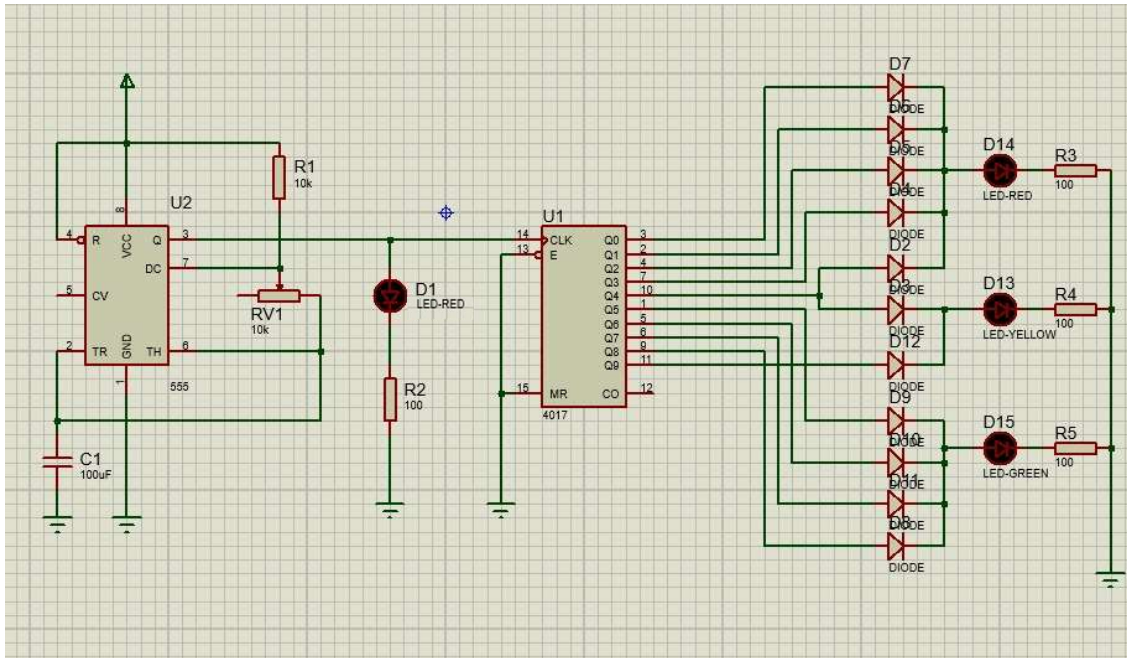
Breadboard of Design

In real life PCB

Final Product