Lab Experiment 6

Digital Systems and Microcontrollers, IIIT-H Spring'21

1.1 Objective:

To build a circuit for a decade counter understand its usage. In this experiment, you need to make a sequential circuit that counts from 0 to 9 and then resets back to 0 and so on. For this experiment you do not "*need*" an Arduino , you can use a Power Supply to drive your circuit.

1.2 Theory:

A decade counter also known as a binary-coded decimal is a serial digital counter that counts ten digits. It resets for every new clock input. It goes through 10 unique combinations of output.
A decade counter counts in a sequence of ten and then returns back to zero after the count of nine. Obviously, to count up to a binary value of nine, the counter must have at least four flip-flops within its chain to represent each decimal digit.

1.2.1 555 timer:

555 timer IC is an integrated circuit (chip) used in a variety of timer, delay, pulse generation, and oscillator applications. This IC is useful for generating accurate time delays and oscillations. It is mainly useful for generating non-sinusoidal waveforms like square, ramp, pulse etc.

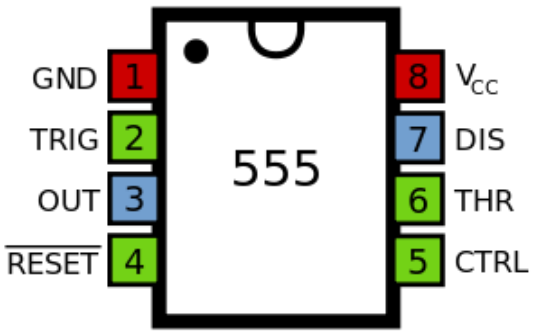


Fig: Pinout of timer

For more details on IC 555 refer to:IC 555

1.2.2 IC 74HC93:

74HC93 are 4-bit binary ripple counters. In a 4-bit ripple counter, the output Q0 must be connected externally to input CP1. The input count pulses are applied to clock input CP0. Simultaneous frequency divisions of 2, 4, 8 and 16 are performed at the Q0, Q1, Q2 and Q3 outputs. As a 3-bit ripple counter, the input count pulses are applied to input CP1. Simultaneous frequency divisions of 2, 4 and 8 are available at the Q1, Q2 and Q3 outputs.

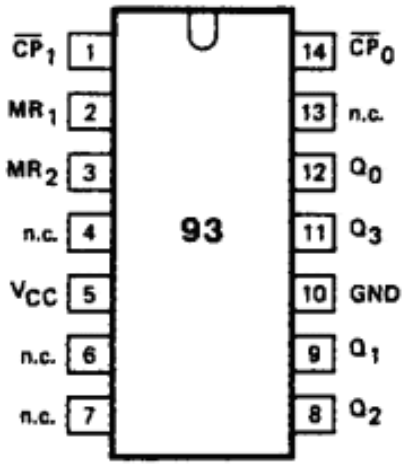


Fig: Pinout of 74HC93

1.2.3 IC CD4511:

IC CD4511 is a BCD to 7-segment latch decoder driver IC. This IC is used where we need to driving common-cathode displays like 7-segment display, low voltage fluorescent display, and incandescent display. It has high output-current-sourcing up to 25mA comes with a lamp test and blanking capability to test the display. It is having a DC supply input that ranges from 3 to 18V.

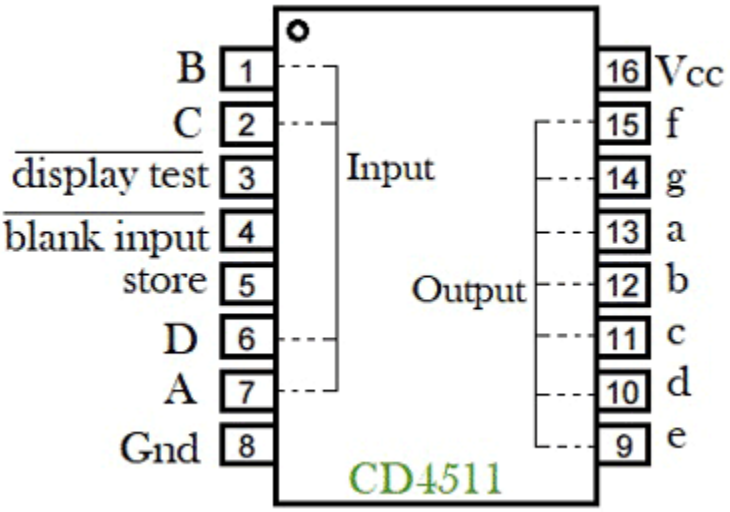
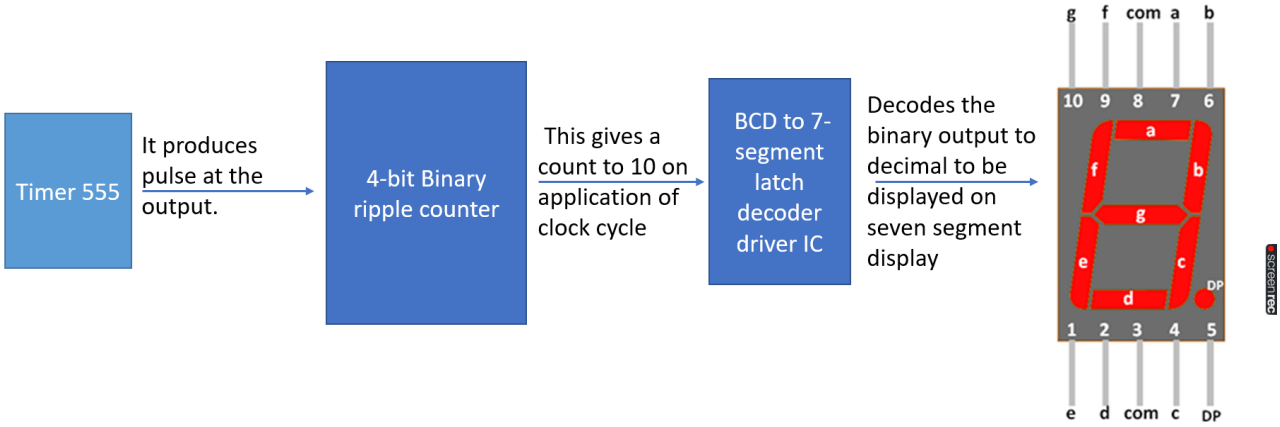


Fig: Pinout of CD4511 IC

1.3 Block diagram:



2.1 Objective

To build a circuit for shift register and understand its usage. This experiment has two parts Part A and Part B (details are given in sec 2.3) using the same circuit.

2.2 Theory

At some time or another, you may run out of pins on your Arduino board and need to extend it with shift registers. This experiment is based on the 74HC595. The datasheet refers to the 74HC595 as an "8-bit serial-in, a serial or parallel-out shift register with output latches; 3-state." In other words, you can use it to control 8 outputs at a time while only taking up a few pins on your microcontroller.

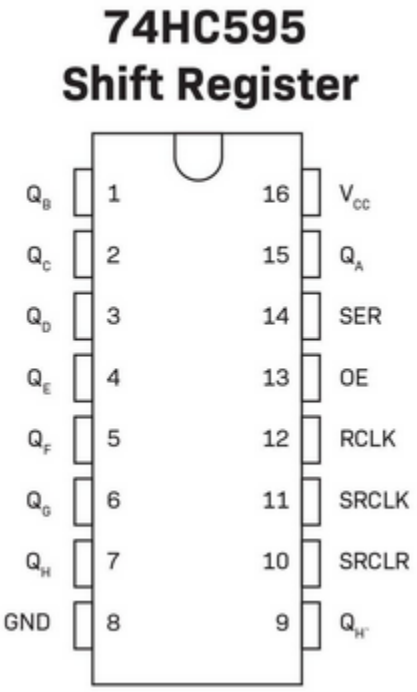


Fig: Pinout of 74HC595 IC

2.3 Experiment

- Give 3 inputs to the 74HC595 IC from the Arduino and other necessary inputs to drive the IC
- Connect the output pins of the IC to 8 LEDs

2.3.1 Part A:

Using the circuit made above write the code to count from 0 to 255 and glow the 8 LEDs in order.

2.3.2 Part B:

Using the circuit made above write the code to take input from the user (range 0-7) and glow the corresponding LED.

Note: You are not allowed to hardcode the outputs, if the shift register logic is not used no marks will be awarded.

2.4 Circuit Diagram

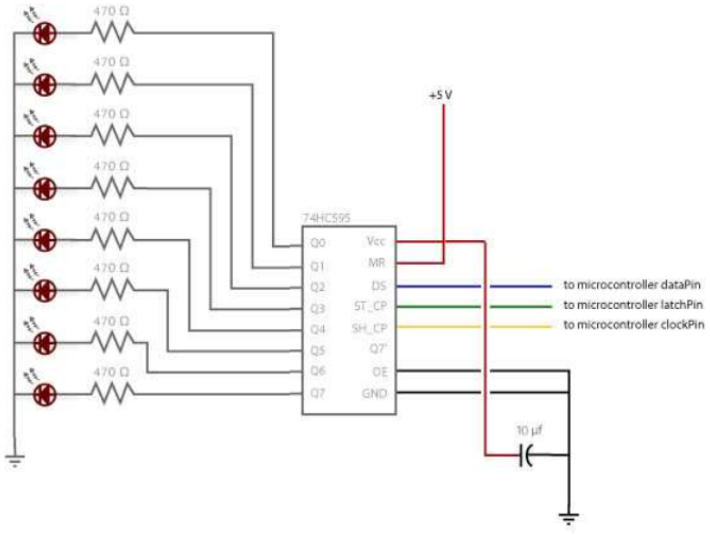


Fig: Circuit Diagram for 2.3A and 2.3B