DSM LAB REPORT - 7

Lab 7: Decade Counter and uses of Shift Register

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Experiment – 1

Objective:

To build a decade counter and understand its usage.

Components Used:

Digital Test Kit, ICs = 74HC93, CD4511, 7 segment display and wires

Reference Circuit:

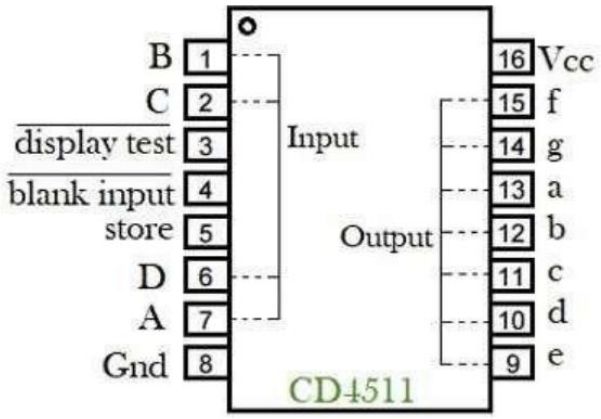


Fig: Pinout of CD4511 IC

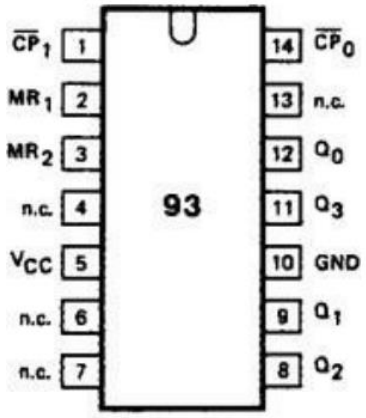
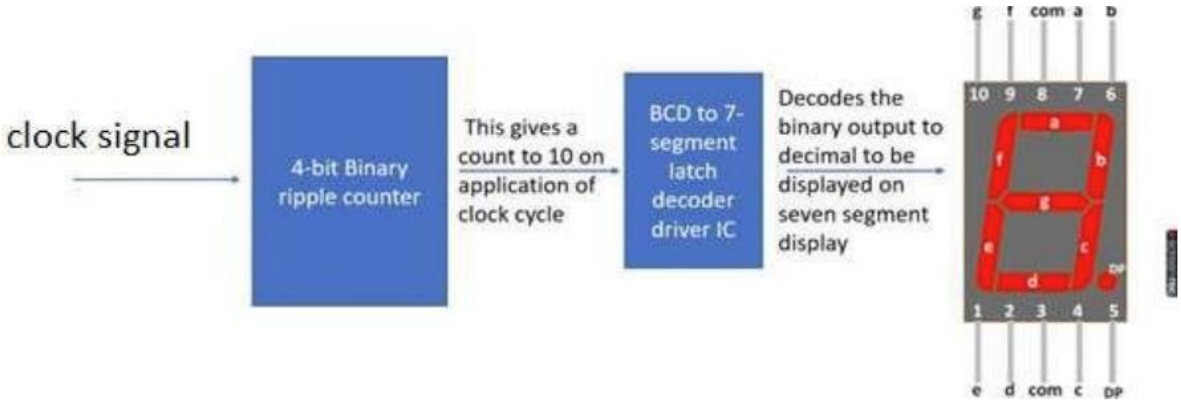


Fig: Pinout of 74HC93



Procedure:

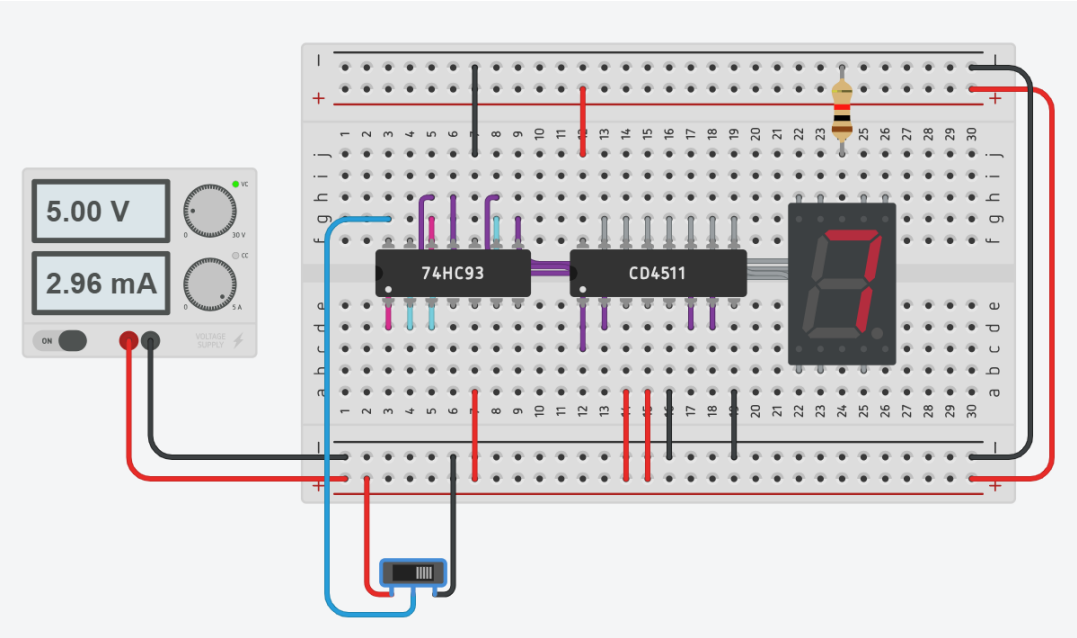
1. Connect the VCC and GND of the Digital Test Kit to the VCC and GND pins of the ICs. The common cathode (com) pin of the 7-segment display should be connected to the GND of the Digital Test Kit.

Ensure this connection is made through a series resistor to prevent the IC from failing or blowing up.

2. Connect the clock to the CPO' of the 74HC93 IC and Q0 to CP1' to make it a 4-bit binary ripple counter. Simultaneous frequency divisions of 2, 4, 8 and 16 are performed at the Q0, Q1, Q2 and Q3 outputs.
3. To convert this 4-bit ripple counter into a BCD counter, connect the master resets, MR1 and MR2, to outputs Q1 and Q3, respectively. The term "MR" refers to master reset. By connecting MR1 to Q1 and MR2 to Q3, the outputs of Q1 and Q3 are effectively ANDed' together. This reset occurs when the output of this AND operation equals 1, which happens when both Q1 and Q3 are high (representing the decimal value 9 in binary). This configuration successfully transforms the 4-bit binary ripple counter into a BCD counter.
4. Connect Q0 to A, Q1 to B, Q2 to C and Q3 to D. This connects the BCD counter to the 7-segment decoder.
5. Connect the pins corresponding to the specific letters of the 7-segment decoder to the 7-segment display.

Tinkercad Simulation:

https://www.tinkercad.com/things/aeSsL2Khb7J-dsmlab7exp1?sharecode=869GINhAOR0Wbjd-LENMfH8ekMcACweWheKs33zPpEU



Output:

Decade Counter.mp4

Observations:

The 7-segment display displays numbers from 0 to 9 and then resets to 0.

Clock Pulse	Display
T1	0
T2	1
T3	2
T4	3
T5	4
T6	5
T7	6
T8	7
T9	8
T10	9
T11	0
T12	1
T13	2
. . .	. . .

Conclusion:

A decade counter successfully assembled, and its uses understood.

Experiment-2(Part A)

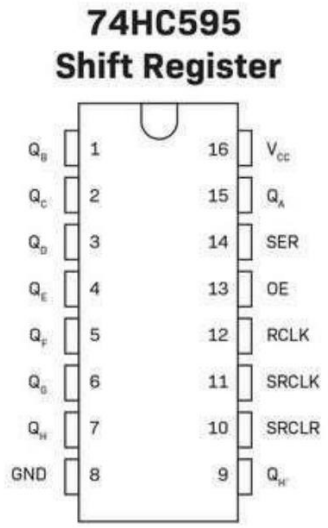
Objective:

To build a circuit for a shift register and write a code to count from 0 to 255 and glow the 8 LEDs in order.

Components Used:

Digital Test Kit, Arduino Uno board, IC = 74HC595 and wires

Reference Circuit:



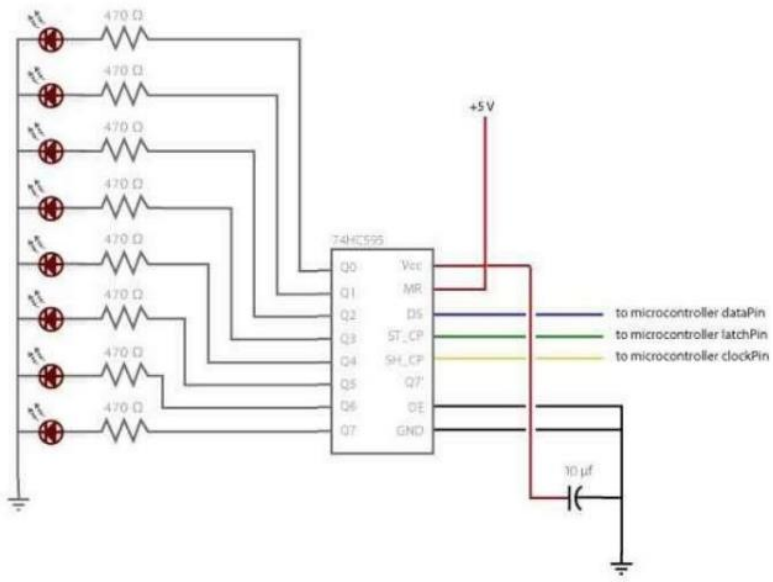


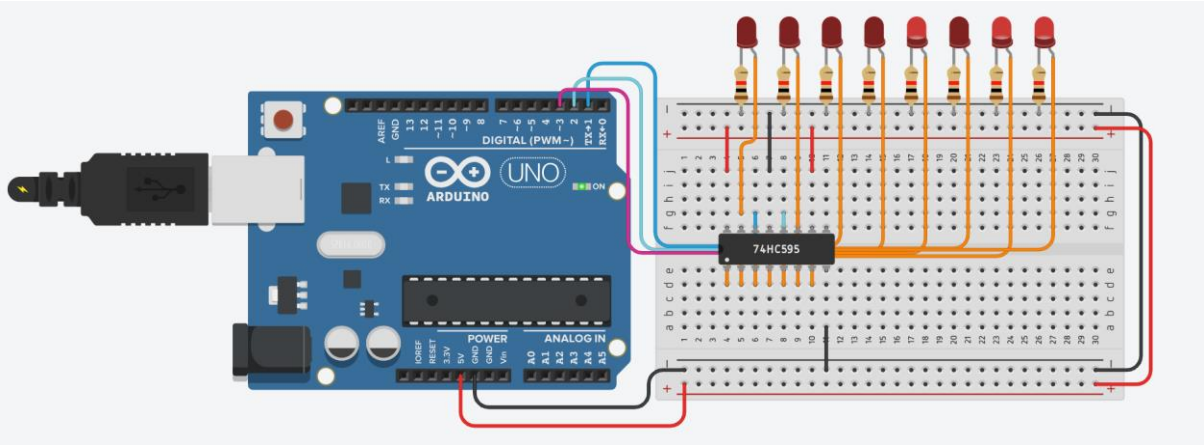
Fig: Pinout of 74HC595 IC

Procedure:

1. Connect the VCC and GND of the Arduino to the VCC and GND pins of the IC.
2. Connect the SRCLK, RCLK, and SER pins of the IC to the digital pins of the Arduino. Ground the OE' pin and connect the SRCLR pin to VCC.
3. Write the necessary code to use the circuit as a counter to count from 0 to 255.

Tinkercad Simulations:

https://www.tinkercad.com/things/b1X3HeQv6BR-dsmlab7exp2a?sharecode=k13cwZ9c4nEuG00a5NFTC8RRNRnrpbugq6a4nrGokys




```
const int ser = 1;
const int srclock = 3;
const int clock = 2;

void setup() {
  pinMode(ser, OUTPUT);
  pinMode(srclock, OUTPUT);
  pinMode(clock, OUTPUT);
}

void loop() {
  for (int i = 0; i < 256; i++) {
    digitalWrite(clock, LOW);
    shiftOut(ser, srclock, LSBFIRST, i);
    digitalWrite(clock, HIGH);
    delay(500);
  }
}
```

Output:

Shift Register 0-255.mp4

Observations:

The LEDs on the Digital Test Kit light up sequentially, counting from 0 to 255 in binary, with HIGH representing '1' and LOW representing '0'.

Conclusion:

A 0-255 counter was successfully made using the circuit.

Experiment-2(Part B)

Objective:

To build a circuit for a shift register and write a code to take input from the user (range 0-7) and glow the corresponding LED.

Components Used:

Digital Test Kit, Arduino Uno board, IC = 74HC595 and wires

Reference Circuit:

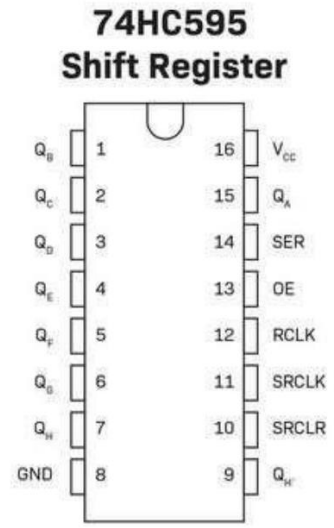
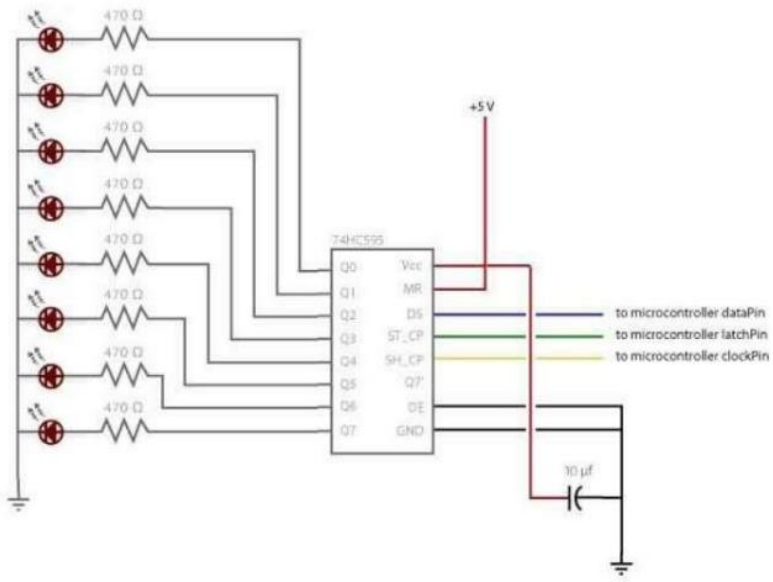


Fig: Pinout of 74HC595 IC

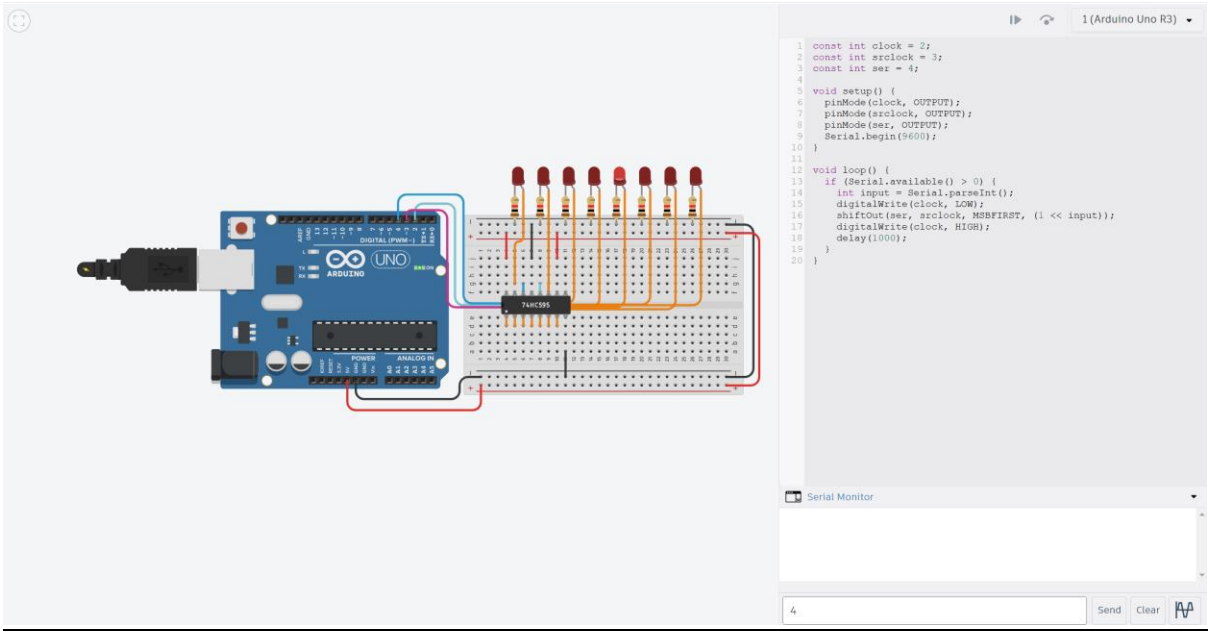


Procedure:

1. Using the circuit made in Part A of Experiment 2, write the necessary code to use the circuit to light up LEDs corresponding to inputs taken from the user.

Tinkercad Simulation:

https://www.tinkercad.com/things/arwR1nJmeLc-dsmlab7exp2b?sharecode=ihzjyeilKVU8r_zecmqXwYJzFLkhSyrT-7Ihq97iJRE



- What the code is essentially doing is, via the bit-shift operator, it is essentially shifting out the binary number corresponding to 2^n where 'n' is the input the user provides.

Observations:

The $(n+1)^{th}$ LED lights up when the user inputs n, following the logic of the bit-shift operator.

Conclusion:

The operation specified for the constructed circuit was successfully implemented.