Non-Blocking LCD (Extended State Machine)

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UCONN

LCD Blocking Data Write Example

```c
void LcdDataWrite(uint8_t da)
{
        // First send higher 4-bits
        DATA_PORT = (DATA_PORT & 0xf0) | (da >> 4);
        CTRL_PORT |= (1<<RS);
        CTRL_PORT |= (1<<ENABLE);
        _delay_ms(1);                           // WASTED CYCLES
        CTRL_PORT &= ~(1<<ENABLE);
        _delay_ms(1);                           // WASTED CYCLES

        // Send lower 4-bits
        DATA_PORT = (DATA_PORT & 0xf0) | (da & 0x0f);
        CTRL_PORT |= (1<<RS);
        CTRL_PORT |= (1<<ENABLE);
        _delay_ms(1);                           // WASTED CYCLES
        CTRL_PORT &= ~(1<<ENABLE);
        _delay_ms(1);                           // WASTED CYCLES
}
```

LCD Non-Blocking Write

In last lab, we implemented the following state machine:

- Split the Blocking-write into 4 states
  - Upper Nibble Setup State (UNSS)
  - Upper Nibble Hold State (UNHS)
  - Lower Nibble Setup State (LNSS)
  - Lower Nibble Hold State (LNHS)

- Transition to next state upon timer interrupt
  - Meanwhile do something else.

!WriteData

Timer
Interrupt

DONE

UNSS

UHSS

Timer
Interrupt

Timer
Interrupt

LNHS

LNSS

Timer
Interrupt
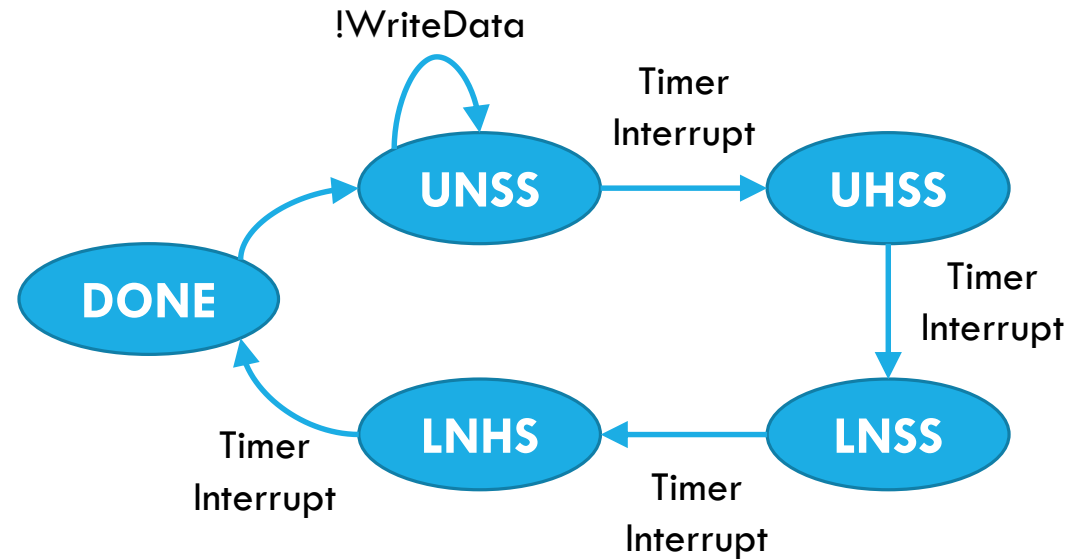
Timer
Interrupt

Task 1: Non-Blocking LCD Command+Data Write

Implement Non-Blocking LCD Writes using the Timer Interrupts and demonstrate LCD refresh rate of **exactly** 1Hz.

In particular, implement the following:

- Implement a non-blocking **LCD_GoTo_and_Write(int x, int y, char data)** function that writes a LCD GoTo command and a data to the resulting location back to back in a truly non-blocking fashion.
    - Implement a large state machine that can handle two back to back LCD write operations.

- Print a different character on LCD after exactly 1 second to show a refresh rate of 1Hz, e.g. first print '0' then '1' after a second, and so on.

- You are **NOT ALLOWED** to use _delay_ms() or _delay_us() functions.

Extended LCD Write State Machine