

7. Delay Implementation Without Library

Delays can be created using nested loops that consume a certain number of clock cycles.

Delay Calculation Concept:

- ATmega328P on Arduino Uno runs at **16 MHz** (16 million clock cycles per second)
- 1 millisecond = 16,000 clock cycles
- `DEC` instruction takes 1 cycle, `BRNE` takes 2 cycles (if branch taken)

Delay Implementation Examples:

```
; Delay approximately 1 second (with nested loop)
delay_1s:
    LDI R18, 64          ; Outer counter
outer_loop:
    LDI R24, lo8(62500) ; Inner counter low byte
    LDI R25, hi8(62500) ; Inner counter high byte
inner_loop:
    SBIW R24, 1         ; Subtract 16-bit counter (2 cycles)
    BRNE inner_loop    ; Loop if not 0 (2 cycles if taken)
    DEC R18             ; Subtract outer counter
    BRNE outer_loop    ; Loop outer if not 0
    RET

; Simple delay with single loop
delay_simple:
    LDI R16, 255        ; Load counter
delay_loop:
    DEC R16             ; Decrement counter (1 cycle)
    BRNE delay_loop    ; Branch if not zero (2 cycles)
    RET                ; Return (approximately 765 cycles total)
```

Revision #1

Created 2026-02-04 06:57:10 UTC by AX

Updated 2026-02-04 06:57:26 UTC by AX