

Solution 2

1.

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#define PAOUT (volatile unsigned char *) 0xFFFFFFFF1
#define PADIR (volatile unsigned char *) 0xFFFFFFFF2
#define PBIN (volatile unsigned char *) 0xFFFFFFFF3
#define PBDIR (volatile unsigned char *) 0xFFFFFFFF5
#define CNTM (volatile unsigned int *) 0xFFFFFDD0
#define CTCON (volatile unsigned char *) 0xFFFFFDD8
#define CTSTAT (volatile unsigned char *) 0xFFFFFDD9
#define IVECT (volatile unsigned int *) (0x20)

interrupt void intserv();

unsigned char digit = 0;          /* Digit to be displayed */
unsigned char led = 0x1;          /* LED state: 0/1 = on/off */

int main() {
    *PADIR = 0xF1;                /* Set Port A direction */
    *PBDIR = 0x00;                /* Set Port B direction */
    *CTCON = 0x02;                /* Stop Timer */
    *CTSTAT = 0x0;                /* Clear "reached 0" flag */
    *CNTM = 100000000;            /* Initialize Timer */
    *IVECT = (unsigned int *) &intserv; /* Set interrupt vector */
    asm("MoveControl PSR,#0x40"); /* CPU responds to IRQ */
    *CTCON = 0x11;                /* Enable Timer interrupts
                                   * and start counting */
    *PAOUT = 0x01;                /* Display 0, turn LED off */
    while (1) {
        while ((*PBIN & 0x1) != 0); /* Wait until SW is pressed */
        while ((*PBIN & 0x1) == 0); /* Wait until SW is released */
        if (led == 0x1) led = 0x0; /* If off, turn LED on */
        else led = 0x1;           /* Else, turn LED off */
        *PAOUT = ((digit << 4) | led); /* Update Port A */
        /* We can also put "*CTCON &= 0xEF;" before and "*CTCON |= 0x10;"
         * after the last statement, to make sure that intserv() is not
         * interfering with main() accessing shared digit/led/PAOUT */
    }

    exit(0);
}

interrupt void intserv() {
    *CTSTAT = 0x0;                /* Clear "reached 0" flag */
    digit = (digit + 1)%10;        /* Increment digit */
    *PAOUT = ((digit << 4) | led); /* Update Port A */
}

```

2.

```

#define PBIN (volatile unsigned char *) 0xFFFFFFFF3
#define PBOUT (volatile unsigned char *) 0xFFFFFFFF4

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#define PBDIR (volatile unsigned char *) 0xFFFFFFF5
#define PCONT (volatile unsigned char *) 0xFFFFFFF7
#define CNTM (volatile unsigned int *) 0xFFFFFFF0
#define CTCON (volatile unsigned char *) 0xFFFFFFF8
#define CTSTAT (volatile unsigned char *) 0xFFFFFFF9
#define IVECT (volatile unsigned int *) (0x20)

interrupt void intserv();

volatile unsigned char led = 0x4; /* 0x0 = LED on, 0x4 = LED off */
volatile unsigned char digit = 0; /* digit for display */

int main() {
    *CTCON = 0x2; /* Stop Timer (if running) */
    *PBDIR = 0xF4; /* Set Port B direction */
    *IVECT = (unsigned int *) &intserv; /* Set interrupt vector */
    asm("MoveControl PSR,#0x40"); /* CPU responds to IRQ */
    *PCONT = 0x40; /* Enable PBIN interrupts */
    *PBOUT = 0x4; /* Turn off LED, display 0 */
    *CNTM = 100000000; /* 1-second timeout */
    *CTCON = 0x1; /* Start countdown */
    while (1) {
        *CTSTAT = 0x0; /* Clear "Reached 0" flag */
        while ((*CTSTAT & 0x1) == 0); /* Wait until 0 reached */
        if (led == 0x4) led = 0x0; /* If off, turn LED on */
        else led = 0x4; /* Else, turn LED off */
        *PBOUT = ((digit << 4) | led); /* Update LED, same display */
    }
    exit(0);
}

interrupt void intserv() {
    unsigned char sample;
    sample = *PBIN & 0x3; /* Read PBIN, isolate bits [1:0] */
    if (sample == 0x2) { /* INC = 0 (increment), DEC = 1 */
        if (digit == 9) digit = 0;
        else digit = digit + 1;
    }
    else if (sample == 0x1) { /* INC = 1, DEC = 0 (decrement) */
        if (digit == 0) digit = 9;
        else digit = digit - 1;
    }
    *PBOUT = ((digit << 4) | led); /* Update display, same LED */
}

```

3.

The LCM (least common multiple) of all four periods is 90; hence, we only need to figure out our RM schedule in the time interval **[0, 90)**, after which it is repeated:

