

Experiment 6: Playing with Time

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Res. Asst. Dr. Yusuf Huseyin Sahin
sahinyu@itu.edu.tr

What is time? In my opinion, time is a concept that we have no control over and can even change.

Ümitcan, Gibi

1 Introduction and Preliminary

In this experiment, timer, one of the most important features of the microprocessors, is explored.

2 (20 pts) Four 7-Segment Displays

In this part, you should write an infinite loop as your main program code in order to lit different digits of 7-segment display panel simultaneously. You should be able to accomplish following output given in Figure 1 as the result of the first part.



Figure 1: Sample output

Hint: If a light flashes in a high frequency, we can not see flashes but only constant light.

3 (20 pts) BCD Conversion Subroutine

Write a subroutine that converts the given binary input (between 0x00000000b and 0x01100011b) to two decimals. For example, for the binary input of 97, the subroutine should return 9 and 7.

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Show the returned values on 7-segment displays, as in Part 1.

4 (30 pts) Timer Interrupt Subroutine

MSP430 family micro-controllers contain two 16-bit timers which could be utilized independently. Basic building blocks of the timer are represented in Figure 2. Basic steps of the configuration and operation of the timer will be explained briefly. For further information, you should read "Timer-A" chapter in "MSP430 User Guide".

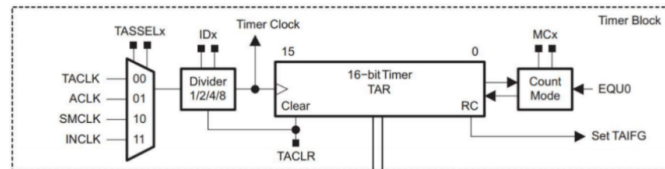


Figure 2: Timer circuit

Timer could use four different signals as counting input. In this experiment you should use SMCLK signal as counting input. SMCLK is a square wave with 1048576 Hz frequency. Timer contains two operation modes (capture and compare) four different timer (counting) modes (Stop, Up, Continues, UpAndDown). We are going to use compare mode with up counting mode in this experiments. The list of the registers you should set are given below. Please check MSP430 User Guide at pages 369-372.

- TimerA Control (TA0CTL): Configuration of the timer
- TimerA Compare Capture (TA0CCR0): Holds the data to compare
- TimerA Comp. Cap. Control (TA0CCTL0): Configuration of Comp/Cap mechanism

Basically you should set the registers with the information given to you at the top. All the important information are given at the top. As you can remember from the previous lab session, microcomputer understands interrupts with interrupt flags and these flags should be cleared before returning from the interrupt. In timer this flag is located in one of the registers on top. Be sure to configure the timer correctly to generate interrupts with 10 msec-period.

To declare the timer interrupt please add the following line in the interrupt vector section of your code. Timer interrupts are handled as an ordinary interrupt from this point on.

```
1 .sect "int09"  
  .short TISR
```

Show that, your code enters the timer interrupt.

5 (30 pts) Chronometer

Using the timer interrupt subroutine, save the centisecond and seconds in two different variables. Convert these values using BCD Conversion subroutine and show the values on 7 segment displays.

Assign three buttons to

- Stop - When this button is pressed, the counter should stop counting.
- Start - When this button is pressed, the counter should start counting.
- Reset - When reset button is pressed, time should be reset back to 0.