MCSL Lab07

STM32 Clock and Timer

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1. Purpose

- Understand the usage of the clock sources of STM32.
- Understand the usage and applications of timer and PWM.

2. Steps

2.1 Modify system initial clock

Here is the code.

2.2 Timer

Here is the code.

2.3 Music keypad, timbre experiment

Here is the code.

3. Results and Analysis

3.1 Modify system initial clock

In this lab, I use the PLL clock as the SYSCL, and use HSI16 as PLL's source clock. In order to create many different HCLK, I adjust the PLLN, PLLM, PLLR, and HPRE in the RCC_PLLCFGR register and RCC_CFGR register according to the formula:
PLLSRC (HSI16) * PLLN / PLLM / PLLR / HPRE = HCLK

The following is a table of the register configuration values used in this exercise. All the values are in MHz.

PLLSRC	PLLN	PLLM	PLLR	HPRE	HCLK	RCC_PLLCFGR
16	12	3	4	16	1	0x03000c22
16	12	1	4	8	6	0x03000c02
16	10	1	4	4	10	0x03000a02
16	12	3	4	1	16	0x03000c22
16	10	1	4	1	40	0x03000a02

Therefore, the first thing is to switch the SYSCLK to the original MSI by changing the value of RCC_CFGR register, and then turn the PLL off by configuring the RCC_CR. We can change the value of RCC_PLLCFGR only after turning off the PLL. The value of RCC_PLLCFGR can be calculated according to the table above. After setting up the value of RCC_PLLCFGR, I turn the HSI16 and PLL on, switching the SYSCLK to PLL, so we have configured the SYSCLK. The final step is to set the HPRE (AHB prescaler) by changing the value of RCC_CFGR, then the HCLK for AHB bus is configured to the desired frequencies.

3.2 Timer

This exercise is a simple timer implementation by polling the counter value. The clock source is the original MSI (4MHz), and the prescaler of TIM2 and auto-reload register are set to be 39999 and 99, respectively. Hence, the frequency of the timer is going to be 100 Hz, and the counter is added by one for each 0.01 second. Whenever the value of the counter (or timer) changed, the displayed number ‘n’ is also added by one until the time limit set by TIME_SEC * 100. The display function used in this exercise is modified for showing the decimal point in the third position of the 7-segment display.

3.3 Music keypad, timbre experiment

This exercise is to generate signals of different frequencies from C4 to C5. The TIM2 is used as a timer as the previous exercise, and the clock source is also the original MSI. The auto-reload register of the timer is fixed to 99. By adjusting the prescaler of the timer, we can generate different frequencies with the following formula:
HCLK / (prescaler + 1) / 100 = desired frequency
So,
prescaler = HCLK / desired frequency / 100 – 1

The duty cycle is initialized to 50, and can be added or subtracted by 5 by pressing button ‘#’ or button ‘*’. To be honest, however, I cannot tell the difference between two signals with the same frequencies but different duty cycles.

4. Reviews and Applications

I think timers, or counters, are very important in many aspects, especially for motor control or other time-critical applications, for instance, the final project that I have not started yet. I think I should be very careful about the frequency of the motor to make it work as expected.