ECE 271 Microcomputer Architecture and Applications
Lab 8: Timer Input Capture in Assembly
Instructor: Prof. Yifeng Zhu
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Goals

1. Understand the basic concept of input capture function of a timer
2. Handle different events in the interrupt service routine
3. Handle timer counter overflow and underflow
4. Use a timer to measure the timestamp of a signal edge (rising or falling edge) external to the microprocessor

Pre-Lab Assignment

1. Read Chapter 15 of the Textbook.
2. Complete the pre-assignment.

In-Lab Requirements

1. Measure the period of a 1Hz square signal by using TIM4 Input Capture and calculate the accuracy
2. Measure distance using the ultrasonic sensor and calculate the accuracy
3. Something cool such as printing distance to the LCD display

Post-Lab Assignment

1. Complete the post-lab report
2. Write your report in Readme.md and submit it

This lab repeats Lab 7. However, you are required to complete the lab in assembly.

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Lab 8 Timer Input Capture
Pre-Lab Assignment

Student Name: _____

1. Configure RCC_AHBENR to enable the clock of GPIO Port B

Register	31	30	29 28	27	26	25	24	23 22 21 20 19 18 17 16	15	14 13	12	11 10 9 8	7	6	5	4	3	2	1	0
AHBENR	Reserved	FSMCEN	Reserved	AESEN	Reserved	DMA2EN	DMA1EN	Reserved	FLITFEN	Reserved	CRCEN	Reserved	GPIOPGEN	GPIOPFEN	GPIOPHEN	GPIOPEEN	GPIOPDEN	GPIOPCEN	GPIOPBEN	GPIOPAEN
Mask																				
Value																				

Write your assembly code below to enable the GPIO B clock:

2. Configure RCC_APB1ENR to enable the clock of Timer 2 and Timer 4

Register	31	30	29	28	27 26 25 24	23	22	21	20	19	18	17	16	15	14	13 12	11	10	9	8 7 6	5	4	3	2	1	0
APB1ENR	COMPEN	Reserved	DACEN	PWREN	Reserved	USBEN	I2C2EN	I2C1EN	USART5EN	USART4EN	USART3EN	USART2EN	Reserved	SPI3EN	SPI2EN	Reserved	WWDGEN	Reserved	LCDEN	Reserved	TIM7EN	TIM6EN	TIM5EN	TIM4EN	TIM3EN	TIM2EN
Mask																										
Value																										

Write your assembly code below to enable the clock of Timer 2 and 4:

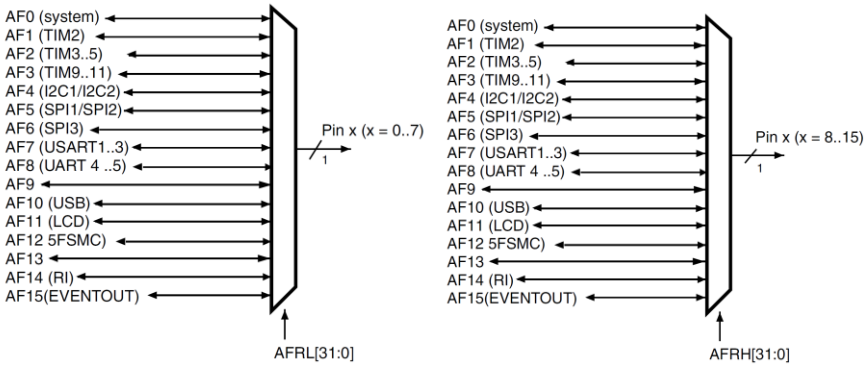
3. Configure PB 6 as Alternative Function Mode

GPIO Mode: Input (00, reset), Output (01), AlterFunc (10), Analog (11)

Register	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIOB MODER	MODER15[1:0]		MODER14[1:0]		MODER13[1:0]		MODER12[1:0]		MODER11[1:0]		MODER10[1:0]		MODER9[1:0]		MODER8[1:0]		MODER7[1:0]		MODER6[1:0]		MODER5[1:0]		MODER4[1:0]		MODER3[1:0]		MODER2[1:0]		MODER1[1:0]		MODER0[:0]	
Mask																																
Value																																

GPIOB Mode Register MASK Value = 0x_____ (in HEX)
GPIOB Mode Register Value = 0x_____ (in HEX)

4. Configure and Select the Alternative Function for PB 6



GPIOx_AFRL[31:00] defines the alternate function for pins 0 to 7, and GPIO_AFHL for pins 8 to 15.

Register	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIOB AFR[0]	AFRL7[3:0]				AFRL6[3:0]				AFRL5[3:0]				AFRL4[3:0]				AFRL3[3:0]				AFRL2[3:0]				AFRL1[3:0]				AFRL0[3:0]			
MASK																																
VALUE																																

GPIOB Alternative Function Register [0] MASK = 0x_____ (in HEX)

GPIOB Alternative Function Register [0] = 0x_____ (in HEX)

5. Complete the following table to configure the Input Capture for Channel 1 of Timer 4

Register	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TIMx_CR1	Reserved																						CKD [1:0]		ARPE	CMS [1:0]		DIR	OPM	URS	UDIS	CEN
Value																																
TIMx_CR2	Reserved																								TI1S	MMS [2:0]			CCDS	Reserved		
Value																																
TIMx_SMCR	Reserved																ETP	ECE	ETP S [1:0]		ETF[3:0]				MSM	TS[2:0]			Reserved	SMS[2:0]		
Value																																
TIMx_DIER	Reserved																	TDE	COMDE	CC4DE	CC3DE	CC2DE	CC1DE	UDE	Reserved	TIE	Reserved	CC4IE	CC3IE	CC2IE	CC1IE	UIE
Value																																
TIMx_SR	Reserved																			CC4OF	CC3OF	CC2OF	CC1OF	Reserved		TIF	Reserved	CC4IF	CC3IF	CC2IF	CC1IF	UIF
Value																																
TIMx_EGR	Reserved																									TG	Reserved	CC4G	CC3G	CC2G	CC1G	UG
Value																																
TIMx_CCMR1 *Input Capture mode*	Reserved																IC2F[3:0]				IC2 PSC [1:0]		CC2 S [1:0]		IC1F[3:0]				IC1 PSC [1:0]		CC1 S [1:0]	
Value																																
TIMx_CCMR2 *Input Capture mode*	Reserved																IC4F[3:0]				IC4 PSC [1:0]		CC4 S [1:0]		IC3F[3:0]				IC3 PSC [1:0]		CC3 S [1:0]	
Value																																
TIMx_CCER	Reserved																CC4NP		CC4P	CC4E	CC3NP		CC3P	CC3E	CC2NP		CC2P	CC2E	CC1NP		CC1P	CC1E

Value		0	erv	0	0	0	erv	0	0	0	erv	0	0	0	erv	0	0
TIMx_CNT	CNT[32:16] (TIM5 only, reserved on the other timers)	CNT[15:0]															
Value																	
TIMx_PSC	Reserved	PSC[15:0]															
Value																	
TIMx_ARR	ARR[32:16] (TIM5 only, reserved on the other timers)	ARR[15:0]															
Value																	
TIMx_CCR1	CCR1[32:16] (TIM5 only, reserved on the other timers)	CCR1[15:0]															
Value																	
TIMx_CCR2	CCR4[32:16] (TIM5 only, reserved on the other timers)	CCR2[15:0]															
Value																	
TIMx_CCR3	CCR4[32:16] (TIM5 only, reserved on the other timers)	CCR3[15:0]															
Value																	
TIMx_CCR4	CCR4[32:16] (TIM5 only, reserved on the other timers)	CCR4[15:0]															
Value																	
TIMx_DCR	Reserved	DBL[4:0]					Reserved	DBA[4:0]									
Value																	
TIMx_DMAR	Reserved	DMAB[15:0]															
Value																	
TIM2_OR	Reserved	ITR1_RMP															
Value																	
TIM3_OR	Reserved	ITR2_RMP															
Value																	

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Lab 8 Timer Input Capture
In-Lab Demo

Part 1: Measure the period of 1 Hz square signal

- Basic requirement: In the debug environment, show the period you have measured. Record the accuracy for the post-lab assignment.
- Something cool: for example, show time measurements on LCD.

Part 2: Interface with Ultrasonic distance sensor

- Basic requirement: In the debug environment, show the distance you have measured. . Record the accuracy for the post-lab assignment.
- Something cool: for example, show distance measurements on LCD.

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Lab 8 Timer Input Capture
Post-Lab Assignment

Write your answers to Readme.md and submit it to Gitlab server:

1. Does the timer counter count up or down in your lab? If counting up, how did you handle the counter overflow? (If counting down, how did you handle the counter underflow?)

2. What is the accuracy when measuring the period of 1Hz square wave?

3. What is the accuracy of the distance you have measured?

4. What is the most challenge issue you had in this lab?

5. Do you have any suggestions or comments of this lab?

6. Do you have any comments of the textbook?