CE2107 Lab3 Assignment Sheet (to be submitted to NTULearn before next lab)

Name: Dayna Chia Lab Group: SE1 Date: 16/10/22

1. Section 6. Other than the procedures outlined in the introduction of Exception Handling, what other registers need to be noted when using the Exception Handling System in ARM Cortex M4F processor? Think global…

PRIMASK and BASEPRI registers

1. Section 6.2. The bump switch used in the lab is shown below. Pin 1 and 3 of the bump switch are connected to the MSP432. Draw the internal circuit of the bump switch and describe how the MSP432 GPIO can be used to detect that the switch is closed?

|  |  |
| --- | --- |
|  |  |

The input pins are configured to internal pull-up so when the switch is open, logic 1 is read. When the switch is closed, current flows from source to ground and logic 0 is read at the input. Thus, it can be detected that the switch is closed when the reading goes from high to low.

1. Section 6.3. Write down the GPIO configuration used for pins connected to the Bump switches.

P4->SEL0 = 0x00;

P4->SEL1 = 0x00;

P4->DIR = 0x00;

P4->REN = 0xED;

P4->OUT = 0xED;

1. Section 6.3. What is the frequency of the clock source of systick timer? Explain how systick timer is configured to interrupt the system at 1000Hz frequency. Illustrate with detail calculations and APIs used.

Frequency of clock source: 48Mhz = 48 x 10^6 Hz

In the main function of Lab3\_Bump\_Reflectance\_Systick, SysTick\_Init(48000,1) is called. As such, an interrupt is generated whenever the timer counts down to 0 from 48000, which takes 1 / (48 x 10^6) x 48000 = 0.001s. Thus, it interrupts the system at 1 / 0.001 = 1000Hz frequency.

1. Section 6.3. What is the advantage the method of reading Reflectance sensor (in Lab3 section 6.3) has compared to the method used in Lab2?

The advantage is that the bump switch is only read when one or more of the bump switches are asserted through an interrupt request, so the CPU does not have to constantly read the bump switch. This frees up the CPU to carry out other tasks instead of having to do periodic polling for the bump switch reading.

1. Section 6.4. Reference to PWM\_Init34() in PWM.c, what is the timer base clock used to increment the counters in Timer\_A0? Show the details of how this base clock of Timer\_A0 is derived, starting from processor clock. Note that SMCLK=12Mhz.

TIMER\_A0->EX0 = 0x0000; // divide by 1

TIMER\_A0->CTL = 0x02F0; // SMCLK=12MHz, divide by 8, up-down mode

Base clock frequency: 12 / 1 / 8 = 1.5Mhz

1. Section 6.5. What is the PWM frequency generated to the motor? illustrate with detail working.

duty3 = 3000, duty4 = 3000

Time taken to count from 3000 to 7500 to 3000: 6.667 x 10^-7 x 9000 = 0.006s

Time taken to count to from 3000 to 0 to 3000: 6.667 x 10^-7 x 6000 = 0.004s

Period: 0.006 + 0.004 = 0.01s -> Frequency: 1 / 0.01 = 100Hz

1. Section 6.5. Is interrupt mechanism used in the PWM generation via Timers?

Yes.

TA0CCR0 interrupt is triggered when timer count value is equal to TA0CCR0 value. Similarly, TA0IV interrupt is triggered when timer count value is equal to TA0CCR3/TA0CCR4 value and when timer count value is equal to 0.

1. Section 6.5. What is the IRQ number corresponding to the interrupt used by Timer\_A1 in Lab3\_TimerCompare\_Motor project use? What is the corresponding Exception number?

IRQ10, Exception number 26