CSE 211: Introduction to Embedded Systems

Section 6

SysTick Timer

- SysTick is a simple counter that we can use to create time delays and generate periodic interrupts.
- The basis of SysTick is a 24-bit down counter that runs at the bus clock frequency.

Systick Timer

- Clear the ENABLE bit to turn off SysTick during initialization.
- Set the RELOAD register.
- Write to the NVIC_ST_CURRENT_R value to clear the counter.
- Set the ENABLE bit to turn on SysTick and set CLK_SRC to 1.

Address	31-24	23-17	16	15-3	2	1	0	Name
$E000E010	0	0	COUNT	0	CLK_SRC	INTEN	ENABLE	NVIC_ST_CTRL_R
$E000E014	0	24-bit RELOAD value						NVIC_ST_RELOAD_R
$E000E018	0	24-bit CURRENT value of SysTick counter						NVIC_ST_CURRENT_R

Table 4.10. SysTick registers.

Systick Timer

- We need to set the ENABLE bit so the counter will run.
- When the CURRENT value counts down from 1 to 0, the COUNT flag is set.
- On the next clock, the CURRENT is loaded with the RELOAD value.
- In this way, the SysTick counter (CURRENT) is continuously decrementing.
- If the RELOAD value is n, then the SysTick counter operates at modulo n+1 (…n, n-1, n-2 … 1, 0, n, n-1, …). In other words, it rolls over every n+1 counts.

Sheet 5

- Write a C function to initialize SysTick Timer with maximum reload value.

Answer

```
void systick_init(void){
NVIC_ST_CTRL_R = 0;
NVIC_ST_RELOAD_R = 0x00FFFFFF;
NVIC_ST_CURRENT_R =0;
NVIC_ST_CTRL_R=0x05;
}
```

Sheet 5

- Write a C function that wait for 1 ms using SysTick timer. Assume the SysTick timer operates on 80 MHZ.

Answer

```
void systick_wait_1ms(){
        NVIC_ST_RELOAD_R = 80,000 -1;
        NVIC_ST_CURRENT_R = 0;
        while ( (NVIC_ST_CTRL_R & 0x00010000) == 0){};
}
```

Sheet 5

- Repeat the previous questions using assembly.

Answer

```
SysTick_Init    LDR R1, =NVIC_ST_CTRL_R
                MOV R0, #0
                STR R0, [R1]
                LDR R1, =NVIC_ST_RELOAD_R
                LDR R0, =0x00FFFFFF
                STR R0, [R1]
                LDR R1, =NVIC_ST_CURRENT_R
                MOV R0, #0
                STR R0, [R1]
                LDR R1, =NVIC_ST_CTRL_R
                MOV R0, #0x05
                STR R0, [R1]
                BX LR
```

```
SysTick_wait_1ms    LDR R1, =NVIC_ST_RELOAD_R
                    LDR R0, = 0x1387F  ;80000 -1
                    STR R0, [R1]
                    LDR R1, =NVIC_ST_CURRENT_R
                    MOV R2,#0
                    STR R2, [R1]
                    LDR R1, =NVIC_ST_CTRL_R
wait_loop           LDR R3, [R1]
                    ANDS R3, R3, #0x00010000
                    BEQ wait_loop
                    BX LR
```

Sheet 5

- Write a C function that uses the function written in Q2 to make a generic delay function that wait for multiples of 1 ms.

Answer

```
#include "systick.h"
#include "delay.h"

void delay(uint32_t time){
        uint32_t i;
        for(i = 0;i < time;i++){
                systick_wait1ms();
        }
}
```

Sheet 5

- Write a C program to flash the RGB LED of TivaC for each color in order red, blue then green, with delay 1 sec between each color, where red color is represented by 0x02, blue color is represented by 0x04, and green color is represented by 0x08. Assume the SysTick timer operates on 80 MHZ.

Answer

```
void main(){

unsigned char led;

while(1){

for(led=0x02;led<=0x08;led=led<<1) {

GPIO_PORTF_DATA_R &=~0E;

GPIO_PORTF_DATA_R |= led;

delay(1000);

}

}

}
```

Thank You