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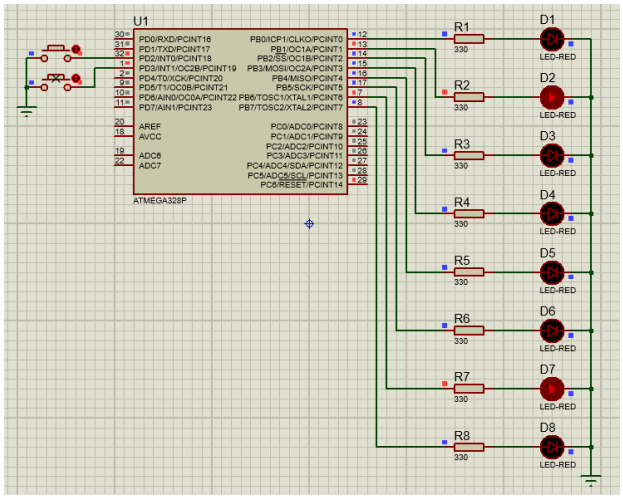
Faculty of Engineering, Department of Computer Engineering

CPE 328 Embedded System, 2/2020

LAB Lecture 11: Real-time operating system

Assign Date: 28 April 2021 Due Date: 4 Mar 2021

Circuit



Code

```
#define F_CPU 8000000L
#include <avr/io.h>
#include <avr/interrupt.h>

#include "FreeRTOS.h"
#include "task.h"
#include "semphr.h"

/* Create semaphore variable for take  */
SemaphoreHandle_t xSemaphore;

/* Interrupt handle when INT0 is interrupt*/
ISR (INT0_vect){
    xSemaphoreGiveFromISR(xSemaphore, NULL);

}

/* Interrupt handle when INT1 is interrupt  */
ISR (INT1_vect){
    xSemaphoreGiveFromISR(xSemaphore, NULL);

}
```

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```c
/* Slow led  */
void buttonHandlerSlow(void* params){
    DDRB |= 0x0f;
    unsigned char led_state[4] = {0x01, 0x02, 0x04, 0x08};
    while(1){
        /* Take semaphore */
        if (xSemaphoreTake(xSemaphore, portMAX_DELAY) == pdTRUE){
            for(int i=0; i < sizeof(led_state); i++){
                PORTB |= led_state[i];
                vTaskDelay(500 / portTICK_PERIOD_MS);
                PORTB &= ~led_state[i];
                vTaskDelay(500 / portTICK_PERIOD_MS);
            }
        }
    }
}

/* Fast led  */
void buttonHandlerFast(void* params){
    DDRB |= 0xf0;
    unsigned char led_state[4] = {0x10, 0x20, 0x40, 0x80};
    while(1){
        if (xSemaphoreTake(xSemaphore, portMAX_DELAY) == pdTRUE){
            for(int i=0; i < sizeof(led_state); i++){
                PORTB |= led_state[i];
                vTaskDelay(250 / portTICK_PERIOD_MS);
                PORTB &= ~led_state[i];
                vTaskDelay(250 / portTICK_PERIOD_MS);
            }
        }
    }
}
```

```c
int main(void) {
    PORTD |= (1 << PORTD2) | (1 << PORTD3);
    EICRA |= (1 << ISC01) | (1 << ISC11);
    EIMSK |= (1 << INT0) | (1 << INT1);

    xSemaphore = xSemaphoreCreateBinary();

    xTaskCreate(buttonHandlerSlow, "slow", configMINIMAL_STACK_SIZE, NULL, 1, NULL);
    xTaskCreate(buttonHandlerFast, "fast", configMINIMAL_STACK_SIZE, NULL, 1, NULL);
    vTaskStartScheduler();
    while(1);
}
```

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1) ให้นักศึกษาออกแบบวงจรและเขียนเฟิร์มแวร์โดยใช้ FreeRTOS ให้มีการทำงานดังนี้
   a. เมื่อกดปุ่ม 1 หลอดไฟ LED ที่ขา PB0 - 3 จะวิ่ง 1 รอบด้วยความเร็วต่ำ
   b. เมื่อกดปุ่ม 2 หลอดไฟ LED ที่ขา PB4 - 7 จะวิ่ง 1 รอบด้วยความเร็วสูง