Embedded RTOS Lab 5: Semaphores

Lab Objective

To demonstrate FreeRTOS task management using the following features: -

- GPIO interfacing with LEDs, Switches
- Task synchronisation using Semaphores
- UART interfacing

Reference: FreeRTOS Reference Manual Chapter

■ Semaphore / Mutexes

xSemaphoreCreateBinary()

xSemaphoreCreateBinaryStatic()

vSemaphoreCreateBinary()

xSemaphoreCreateCounting()

xSemaphoreCreateCountingStatic()

xSemaphoreCreateMutex()

xSemaphoreCreateMutexStatic()

xSem'CreateRecursiveMutex()

xSem'CreateRecursiveMutexStatic()

vSemaphoreDelete()

xSemaphoreGetMutexHolder()

uxSemaphoreGetCount()

xSemaphoreTake()

xSemaphoreTakeFromISR()

xSemaphoreTakeRecursive()

xSemaphoreGive()

xSemaphoreGiveRecursive()

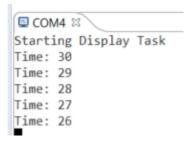
xSemaphoreGiveFromISR()

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Part A: Countdown Timer

Create a project with a single task that counts down every second.

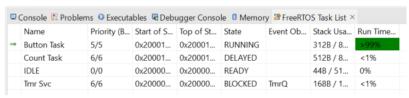
- The timer starts counting down from 30 seconds on start-up.
- LED2 toggles every second when the time is 10 seconds or less.
- The timer stops when it reaches 0 seconds.



Part B: Using a Semaphore to Synchronise 2 Tasks

Create a second task called buttonTask. This task should read the switch and send a semaphore to the countdown task when the switch is pressed. On taking the semaphore, the countdown task should re-start the timer at its initial count.





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Part C: UART Data Input

Add a third task to interface to the UART. The user types the character 'p' into the serial terminal to pause or restart the timer countdown. The UART task should then send a semaphore. The countdown task should take the semaphore and pause or restart the countdown timer.

See the UART Receive Polling padlet for more information on the UART receive API functions.

```
Starting Display Task
Time: 30
Starting UART Task
Starting Button Task
Time: 29
Time: 28
Character Received: p
UART Semaphore Taken

Pausing Timer
Time: 27
Time: 27
Time: 27
Time: 27
Character Received: p
UART Semaphore Taken

Restarting Timer
Time: 27
Time: 27
Character Received: p
UART Semaphore Taken

Restarting Timer
Time: 27
Time: 26
Time: 25
Time: 24
Time: 23
Time: 22
Button Pressed, Giving Semaphore
Button Semaphore Taken, Resetting Timer

Time: 30
Time: 29
Time: 28
Time: 28
Time: 27
```

