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RTOS Basics : Semaphore

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What is a Semaphore ?

Consider a situation where there are two person who wants to share a bike. At one time only one person can use the bike. The one who has the bike key will get the chance to use it. And when this person gives the key to 2nd person, then only 2nd person can use the bike.

Semaphore is just like this **Key** and the bike is the shared resource. Whenever a task wants access to the shared resource, it must acquire the semaphore first. The task should release the semaphore after it is done with the shared resource. Till this time all other tasks have to wait if they need access to shared resource as semaphore is not available. Even if the task trying to acquire the semaphore is of higher priority than the task acquiring the semaphore, it will be in wait state until semaphore is released by the lower priority task.

Use of Semaphore

1. Managing Shared Resource
1. Task Synchronization

Apart from managing shared resource, task synchronization can also be performed with the help of a semaphore. In this case semaphore will be like a flag not key.

1. Unilateral Rendezvous

This is one way synchronization which uses a semaphore as a flag to signal another task.

1. Bilateral Rendezvous

This is two way synchronization performed using two semaphores. A bilateral rendezvous is similar to a unilateral rendezvous, except both tasks must synchronize with one another before proceeding.

Types of semaphore

1. Binary Semaphore

Binary semaphore is used when there is only one shared resource.

1. Counting Semaphore

To handle more then one shared resource of same type, counting semaphore is used.

1. Mutual Exclusion Semaphore or Mutex

To avoid extended priority inversion, mutexes can be used. You can check Mutex Working [here](#).

Operations on Semaphore

Basically, there are 3 operations related to the semaphore:

1. Create
2. Acquire
3. Release

API Details

To create semaphore

{{#Widget:LibTable}}

Defination	vSemaphoreCreateBinary(xSemaphoreHandle xSemaphore)
Input Arguments	xSemaphoreHandle : It is a handle to the created semaphore. It can be used futher to use other semaphore APIs.
Return Value	none
Description	It creates binary semaphore. It writes non NULL value to the argument xSemaphoreHandle if semaphore is created.
Usage	xSemaphoreHandle Sem_A = NULL; vSemaphoreCreateBinary(Sem_A);

To acquire semaphore

{{#Widget:LibTable}}

Defination	xSemaphoreTake(xSemaphoreHandle xSemaphore, portTickType xBlockTime)
Input Arguments	xSemaphoreHandle : It is a handle to the semaphore being obtained. portTickType : The time in ticks to wait for the semaphore to become available.
Return Value	TRUE if semaphore is obtained else FLASE.
Description	It is used to request to acquire the semaphore. The macro portTICK_RATE_MS can be used to convert this the portTickType to a real time. A block time of zero can be used to poll the semaphore.
Usage	xSemaphoreTake(Sem_A,50);

To release semaphore

{{#Widget:LibTable}}


Defination	xSemaphoreGive(xSemaphoreHandle xSemaphore)
Input Arguments	xSemaphoreHandle : It is a handle to the semaphore being released.
Return Value	TRUE if semaphore is released else FLASE.
Description	It is used to release the semaphore. Don't use this API to release semaphore from ISR.
Usage	xSemaphoreGive(Sem_A);

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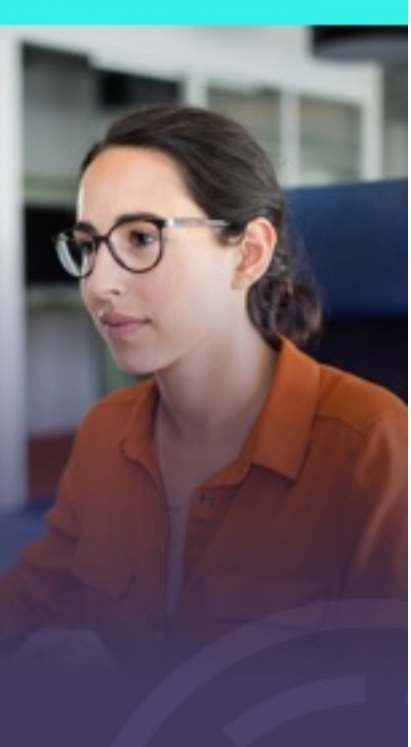
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