

RTOS to maximize CPU Utilization

RTOS (Real-Time Operating System) is an operating system designed to meet the needs of real-time application, i.e. applications with timing constraints to complete a given task in certain time period. While it is not a required component of an embedded system, the use of RTOS will bring many benefits to the system.

For a single processor system, RTOS can help in two ways to maximize CPU utilization, e.g. with multitasking and priority scheme. Let us examine how each of these RTOS features can help to achieve such goal.

Concept of Multitasking in RTOS

Take a simple system with two tasks, Task A and Task B, with its execution period as 100 ms and 20 ms respectively. Without RTOS multitasking, the tasks are running sequentially.

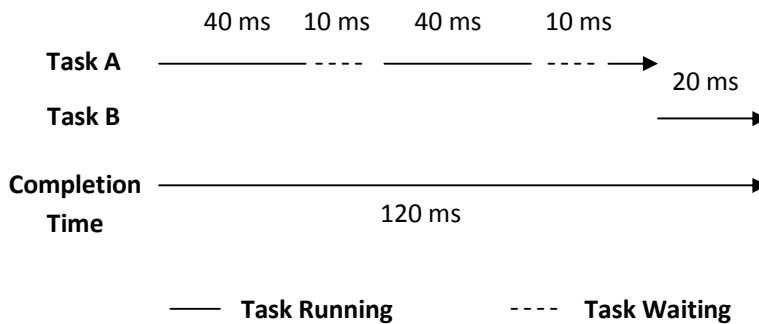


Figure 1 – Sequential Task Execution

With multitasking, Task B will get control of CPU when Task A is in waiting mode (e.g. wait for a resource to be available). By increasing CPU usage during Task A idle period, the completion time for Task A and Task B is shorten by 20 ms i.e. 17%. Task B gets to finish earlier too.

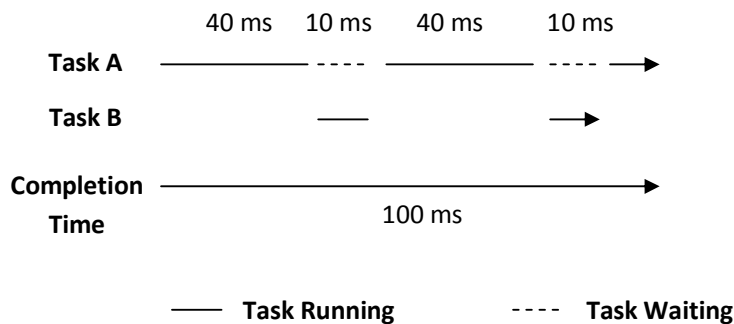


Figure 2 – Multitasking Task Execution

Priority Scheme

Without using RTOS, tasks are usually handled in the order they arrive. Therefore the waiting time for a task to be executed varies, depending on what other tasks are queued up in front of it.

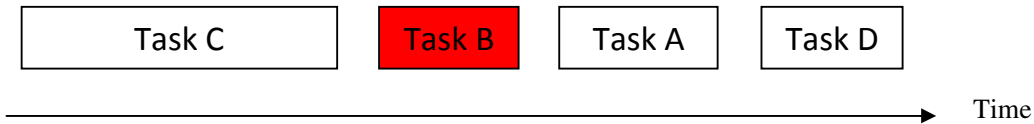


Figure 3 – First Come First Serve

Figure 3 shows that Task B has to wait much longer if the tasks in front have long execution time. If Task B is a critical activity that needs to response quickly, this will lead to degraded system performance or even failed the deadline.

If a priority scheme is used, for example, assigning task with shorter execution period with higher priority, the task execution order will be shown below.

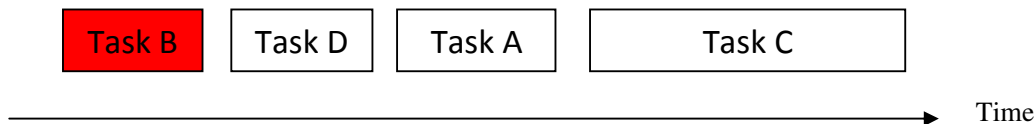


Figure 4 – Priority: Shortest Task First

Figure 4 shows a priority based task scheduling, tasks with shorter execution time scheduled first. This will improve overall system responsiveness and ensure proper utilization of CPU.

RTOS has many features to allow system designer to achieve high CPU utilization. This article illustrated how RTOS can help with its built-in multitasking and priority scheme.

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