

System Verification

Introduction:

In order to verify the EDF scheduler, we will implement an application of 6 tasks as follows:

Task_1, Task_2: will monitor rising and falling edge on button_1 and button_2 and send this event to the consumer task.

Task_3: will send periodic string every 100ms to the consumer task

Task_4: This is the consumer task which will write on UART any received string from other tasks.

Task_5, Task_6: These two tasks shall be implemented as an empty loop that loops X times. You shall determine the X times to achieve the required execution time mentioned above. (Hint: In run-time use GPIOs and logic analyzer to determine the execution time)

Tasks:

| Name | Periodicity (ms) | Deadline (ms) |
|----------------------|------------------|---------------|
| Button_1_Monitor | 50 | 50 |
| Button_2_Monitor | 50 | 50 |
| Periodic_Transmitter | 100 | 100 |
| Uart_Receiver | 20 | 20 |
| Load_1_Simulation | 10 | 10 |
| Load_2_Simulation | 100 | 100 |

Analytical Method:

Hyper period:

Hyperperiod =Least Common Multiplier (50, 50, 100, 20, 10, 100)

Hyperperiod = 100ms

CPU Load:

| Name | Execution Time | OccurrenceDuringHyperperiod |
|----------------------|----------------|-----------------------------|
| Button_1_Monitor | 0.008 | 2 |
| Button_2_Monitor | 0.008 | 2 |
| Periodic_Transmitter | 0.0096 | 1 |
| Uart_Receiver | 0.017 | 5 |
| Load_1_Simulation | 5ms | 10 |
| Load_2_Simulation | 12ms | 1 |

CPU Load = $[(0.008 \times 2) \times 2 + (0.0096 \times 1) + (0.017 \times 5) + (5\text{ms} \times 10) + (12\text{ms} \times 1)] / 100 = 0.62 = 62\%$

Schedulability:

1. Rate-Monotonic Analysis:

$$\sum_{k=0}^n \frac{C_i}{P_i} \leq n(2^{\frac{1}{n}} - 1)$$
$$LHS = \frac{0.008}{50} + \frac{0.008}{50} + \frac{0.0096}{100} + \frac{0.071}{20} + \frac{5}{10} + \frac{12}{100} = 0.621$$
$$RHS = 6 \left(2^{\frac{1}{6}} - 1 \right) = 0.735$$

So, the system is schedulable: $LHS \leq RHS$

2. Time Demand Analysis:

As a Rate-Monotonic Scheduler: The smaller the periodicity, the higher the priority.

| Name | Periodicity (ms) | Execution Time (ms) |
|----------------------|------------------|---------------------|
| Load_1_Simulation | 10 | 5 |
| Uart_Receiver | 20 | 0.017 |
| Button_1_Monitor | 50 | 0.008 |
| Button_2_Monitor | 50 | 0.008 |
| Periodic_Transmitter | 100 | 0.0096 |
| Load_2_Simulation | 100 | 12 |

Critical Instant = 100ms

$$W_1(10) = 5 + 0 = 5 < \text{deadline}$$

$$W_2(20) = 0.017 + \frac{20}{10} * 5 = 10.017 < \text{deadline}$$

$$W_3(50) = 0.008 + \frac{50}{10} * 5 + \frac{50}{20} * 0.017 = 25.059 < \text{deadline}$$

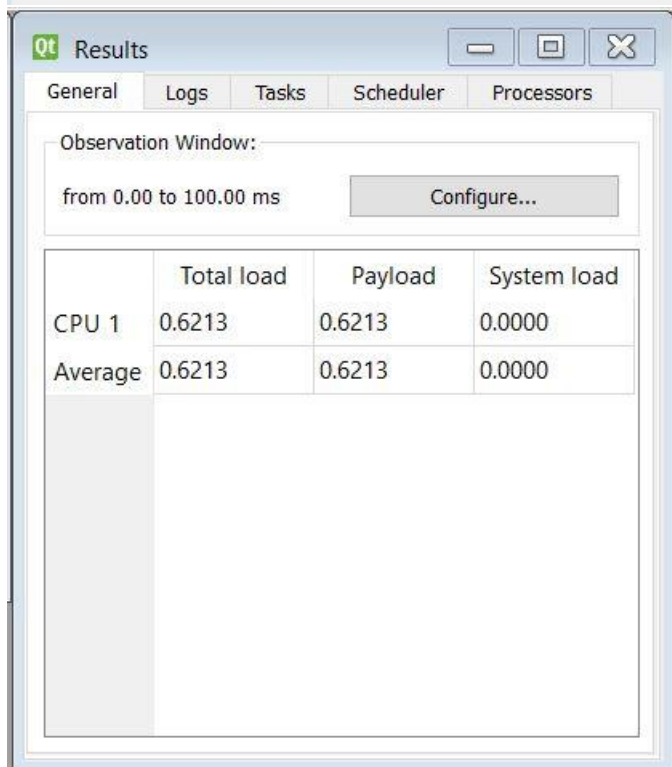
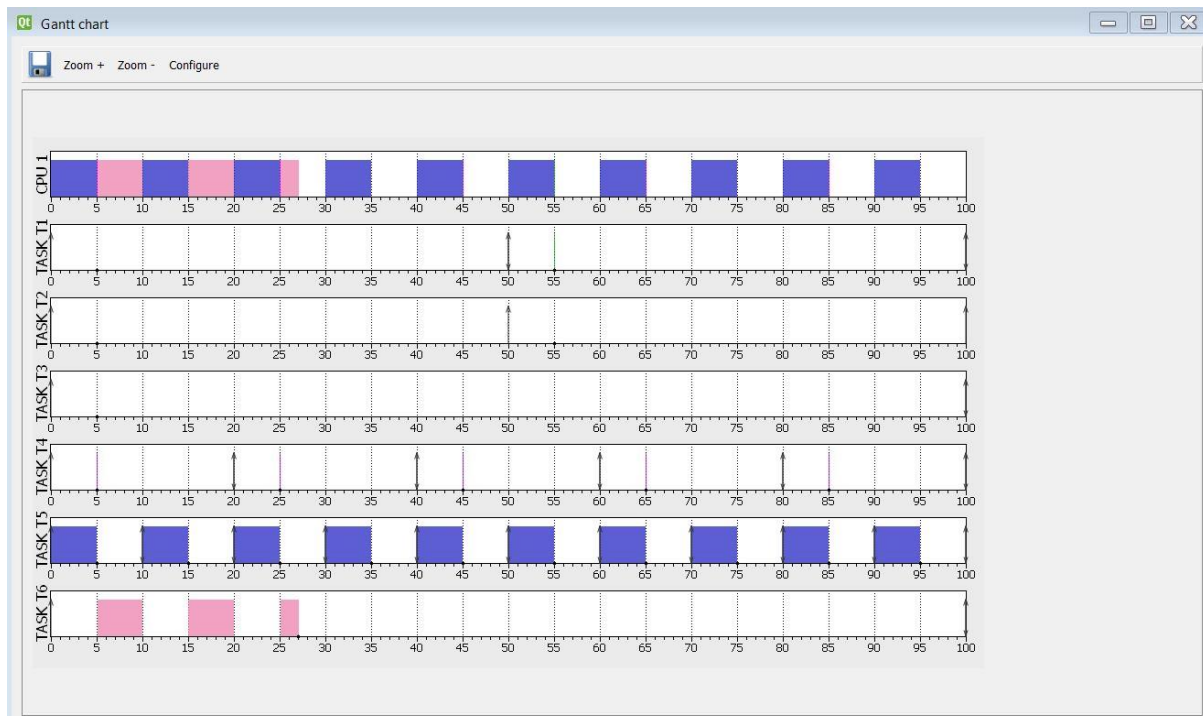
$$W_4(50) = 0.008 + \frac{50}{10} * 5 + \frac{50}{20} * 0.017 + \frac{50}{50} * 0.008 = 25.067 < \text{deadline}$$

$$W_5(100) = 0.0096 + \frac{100}{10} * 5 + \frac{100}{20} * 0.071 + \frac{100}{50} * 0.008 * 2 = 50.1266 < \text{deadline}$$


$$W_6(100) = 12 + \frac{100}{10} * 5 + \frac{100}{20} * 0.071 + \frac{100}{50} * 0.008 * 2 + \frac{100}{100} * 0.0096 = 61.1266 < \text{deadline}$$

So, all tasks are less than the deadline → System is Schedulable

SimSo Simulation:



Keil Simulation:

| Watch 1 | | |
|--|--------|------|
| Name | Value | Type |
|  execution_time | 859192 | uint |
|  cpu_load | 63 | uint |
| <Enter expression> | | |

