System Verification

Tasks:

Note: all tasks execution time is calculated from the actual implemented tasks using GPIOs and the logic analyzer.

Task Name	*Periodicity / Deadline (MS)*	*Execution Time (MS)*
Button_1_Monitor	50	0.0053
Button_2_Monitor	50	0.0053
Periodic Transmitter	100	0.00963
UART Receiver	20	0.0177
Load 1 Simulation	10	5
Load 2 Simulation	100	12

Methods of Verification:

1- Using Analytical Method:

1.1. System Hyper period:

- It's the Least Common Multiple of all task periods
- H = LCM (50, 50, 100, 20, 10, 100) = 100

1.2. CPU Load

- U = (E1 + E2 + E3 + E4 + E5 + E6) / H
- where E is the Execution time and H is the Hyper period.
- U = (0.008*2 + 0.008*2 + 0.0096 + 0.017*5 + 5*10 + 12) / 100 = 0.621 (62.1%)

1.3. System stimulability check using URM and Time Demand Analysis Techniques:

- $\sum_{i=1}^{n} \frac{c_i}{p_i} \leq n(2^{\frac{1}{n}} - 1)$
- $L.H.S = \sum_{i=1}^{n} \frac{c_i}{p_i} = \frac{0.0053}{50} + \frac{0.0053}{50} + \frac{0.00963}{100} + \frac{0.0177}{20} + \frac{5}{10} + \frac{12}{100} = 0.6212$
- $R.H.S = n\left(2^{\frac{1}{n}} - 1\right) = 0.7348$
- $L.H.S \leq R.H.S$ so, the system is schedulable.

2- Time Demand Analysis:

a- Sort the tasks making the highest priority at the first:

Task Name	Periodicity / Deadline (MS)	Execution Time (MS)
1- Load 1 Simulation	10	5
2- UART Receiver	20	0.0177
3- Button_1_Monitor	50	0.0053
4- Button_2_Monitor	50	0.0053
5- Periodic Transmitter	100	0.00963
6- Load 2 Simulation	100	12

b- Choose the critical instant 0 then:

$w_1(10) = 5 + 0 = 5 < deadline$ $\quad$ $w_2(20) = 0.0177 + 5 * \frac{20}{10} = 5.0177 < deadline$

$$w_3(50) = 0.0053 + 0.0177 * \frac{50}{20} + 5 * \frac{50}{10} = 25.049 < deadline$$

$$w_4(50) = 0.0053 + 0.0053 * \frac{50}{50} + 0.0177 * \frac{50}{20} + 5 * \frac{50}{10} = 25.055 < deadline$$

$$w_5(100) = 0.00963 + 0.0053 * \frac{100}{50} + 0.0053 * \frac{100}{50} + 0.0177 * \frac{100}{20} + 5 * \frac{100}{10} = 50.1193 < deadline$$

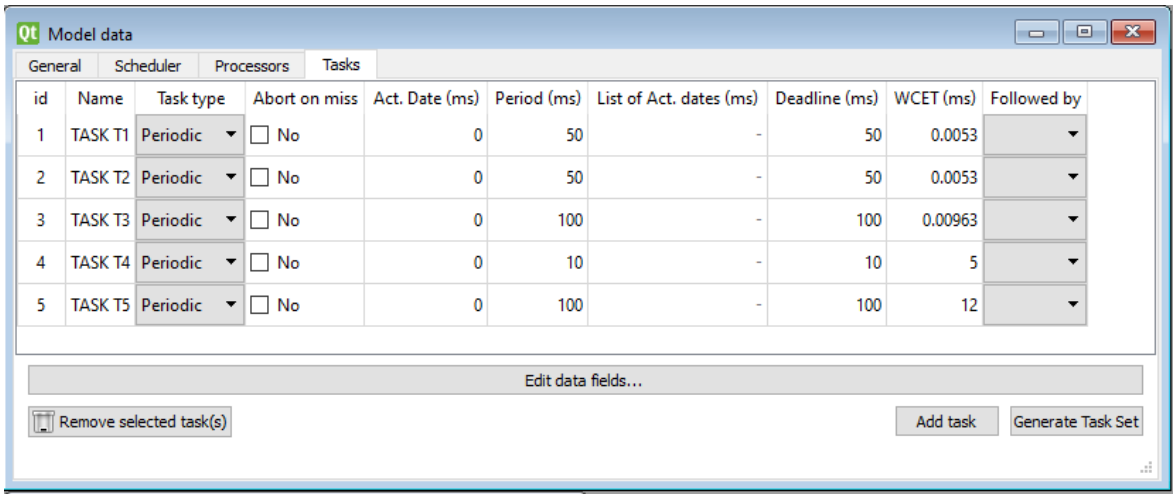
$$w_6(100) = 12 + 0.0096 * \frac{100}{100} + 0.008 * \frac{100}{50} + 0.008 * \frac{100}{50} + 0.017 * \frac{100}{20} + 5 * \frac{100}{10} = 62.1193 < deadline$$

As all Tasks are less Than the deadline. So, the system is schedulable.

3- Using SIMSO offline simulator:

Used Scheduler: Fixed priority rate monotonic.

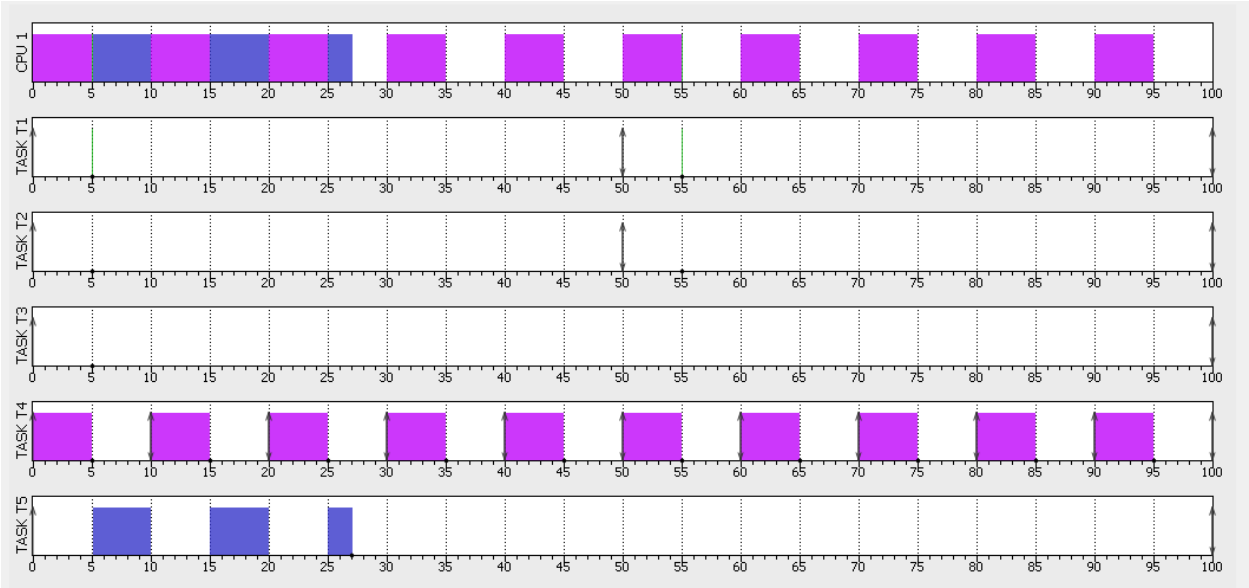
Tasks Simulated:



For The CPU load the is the same as the analytical mode

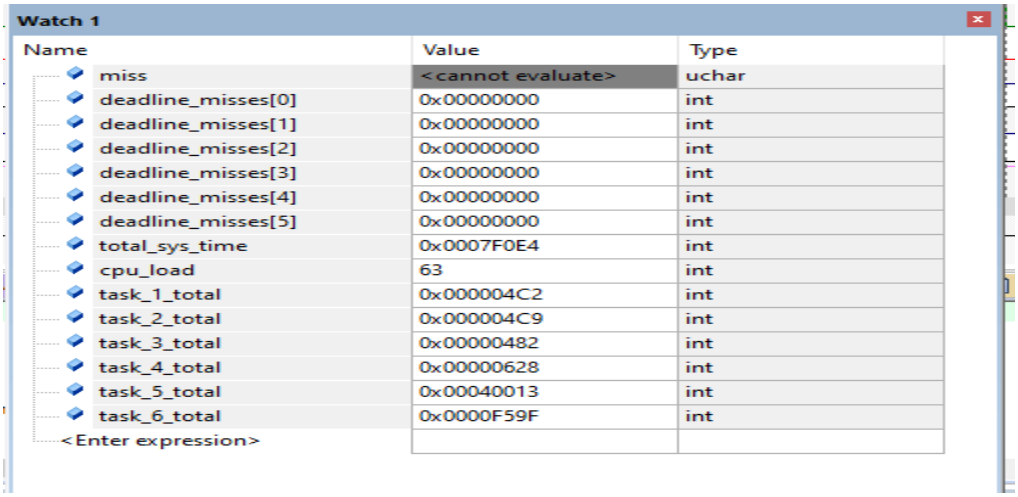
	Total load	Payload	System load
CPU 1	0.6203	0.6203	0.0000
Average	0.6203	0.6203	0.0000

Gantt chart over the Hyper period:



3- Using Keil Simulator at Runtime:

1- Calculate the CPU usage time using timer 1 and trace macros:



Note:

1- The CPU load is the same as the calculated analytically and the obtained using SIMSO offline simulator.
2- None of The Tasks Miss the Deadline.

2. Using trace macros and GPIOs, plot the execution of all tasks, tick, and the idle task on the logic analyzer: