1. System Tasks Parameters

Task	*Periodicity*
Btn1	50
Btn2	50
Tx	100
Rx	20
Ld1	10
Ld2	100

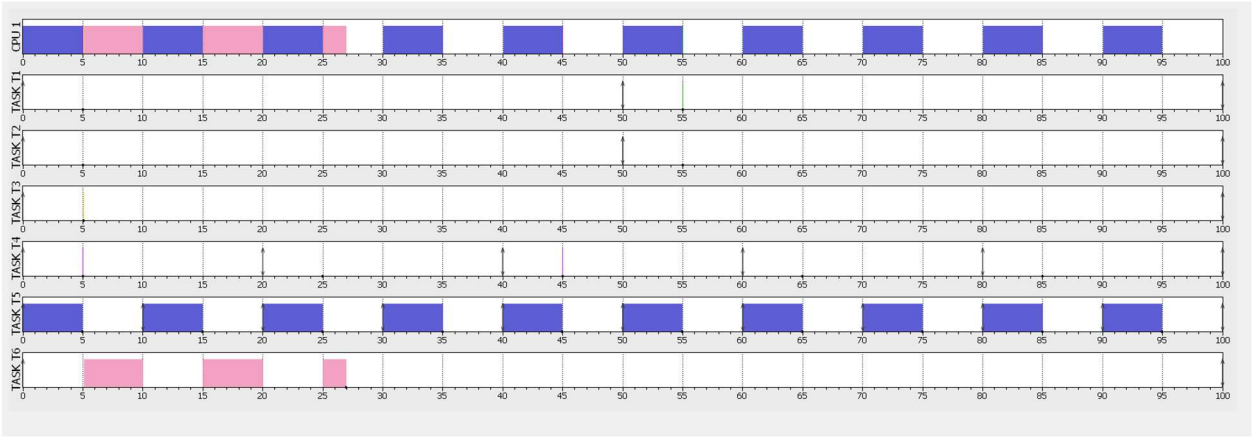
2. Hyperperiod:
   Hyperperiod = LCM (50,50,100,20,10,100) = 100 ms

3. CPU Load:

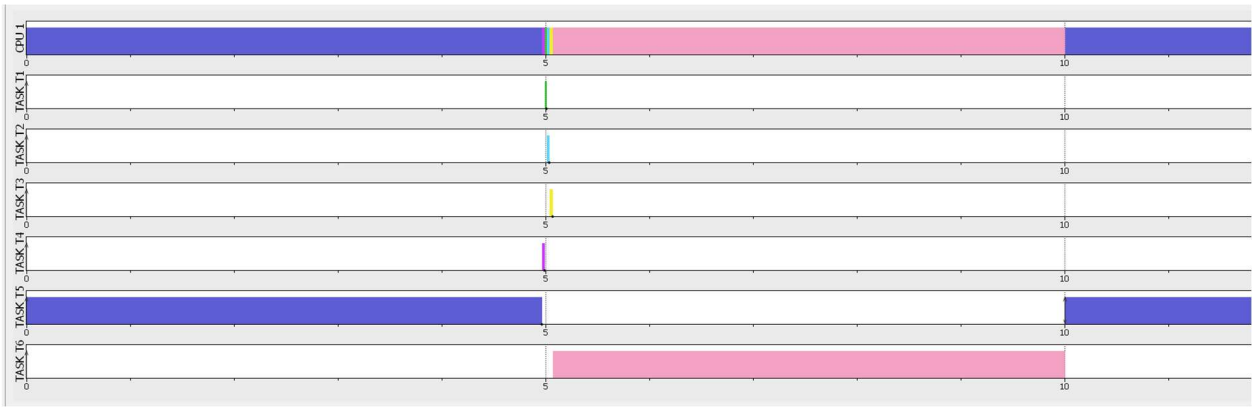
id	Name	Task type	Abort on miss	Act. Date (ms)	Period (ms)	List of Act. dates (ms)	Deadline (ms)	WCET (ms)
1	TASK T1	Periodic	☑ Yes	0	50	-	50	0.02197
2	TASK T2	Periodic	☑ Yes	0	50	-	50	0.02197
3	TASK T3	Periodic	☑ Yes	0	100	-	100	0.0356
4	TASK T4	Periodic	☑ Yes	0	20	-	20	0.0268
5	TASK T5	Periodic	☑ Yes	0	10	-	10	4.96
6	TASK T6	Periodic	☑ Yes	0	100	-	100	11.93

	Total load	Payload	System load
CPU 1	0.6179	0.6179	0.0000
Average	0.6179	0.6179	0.0000

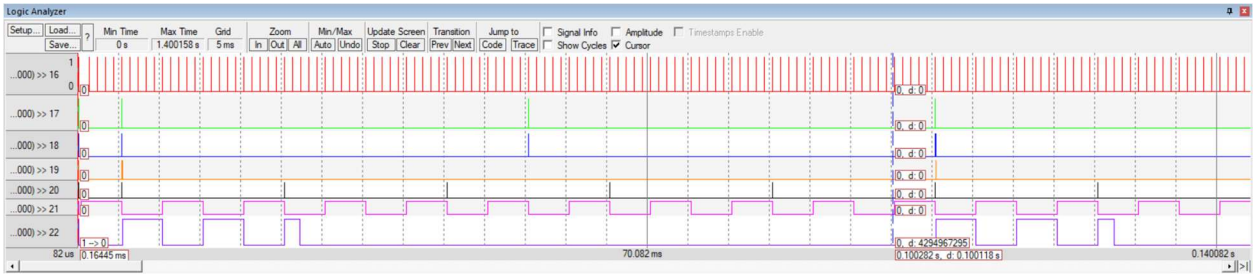
Task	min	avg	max	std dev	occupancy
TASK T1	0.022	0.022	0.022	0.000	0.000
TASK T2	0.022	0.022	0.022	0.000	0.000
TASK T3	0.036	0.036	0.036	0.000	0.000
TASK T4	0.027	0.027	0.027	0.000	0.001
TASK T5	4.960	4.960	4.960	0.000	0.496
TASK T6	11.930	11.930	11.930	0.000	0.119



Note: Tasks 1, 2, 3 have very small execution time in scale of us so they are not clear enough but they are existed when zooming in:



And this is on runtime:



4. Utilization:
   %U = (Total Execution Time over one Hyperperiod / Hyperperiod) x 100
   = (61.79 / 100) x 100 = 61.79%

5. System Schedulability:
   a. Rate Monotonic:

$$U \leq n(2^{\frac{1}{n}} - 1)$$

U = 61.79%

N = 6

$$\therefore U_{rm} = 6 * (2^{\frac{1}{6}} - 1) = 0.7347$$

$$\therefore U < U_{rm}$$

$\therefore$ The System is Schedulable

b. Time Demand Analysis:

$$W_i = e_i + \sum_{k=1}^{i-1} \left\lceil \frac{t}{p_k} \right\rceil e_k$$

W: Worst Response Time

E: Task Execution Time

T: Time Instance

P: Task Periodicity

I: Task Number

Note: The worst case is when all tasks are being scheduled (High Load) at the start of Hyperperiod, so the worst case is 100 ms

A. Task 1: Button 1 Monitor Task {P: 50, E: 0.02197, D: 50} ms

$W_3(50) = 0.02197 + 0.02197 + 0.0356 + (6 \times 5) + (3 \times 0.0268) = 30.15994 < 50$

Then, Button 1 Task is schedulable

B. Task 2: Button 2 Monitor Task {P: 50, E: 0.02197, D: 50} ms

$W_4(50) = (2 \times 0.02197) + 0.02197 + 0.0356 + (6 \times 5) + (3 \times 0.0268) = 30.18191 < 50$

Then, Button 2 Task is schedulable

C. Task 3: Periodic Transmitter Task {P: 100, E: 0.0356, D: 100}

$W_5(100) = (2 \times 0.02197) + (2 \times 0.02197) + 0.0356 + (10 \times 5) + (5 \times 0.0268) + (1 \times 11.93) = 62.18748 < 100$

Then, Periodic Transmitter Task is schedulable

D. Task 4: UART Receiver Task {P: 20, E: 0.0268, D: 20} ms

$W_2(20) = 0.0268 + (1 \times 4.96) = 4.9868 < 20$

Then, UART Receiver Task is schedulable

E. Task 5: Load 1 Task {P: 10, E: 4.96, D: 10} ms

$W_1(10) = 4.96 + 0 = 4.96 < 10$

Then, Load 1 Task is schedulable

F. Task 6: Load 2 Task {P: 100, E: 11.93, D: 100} ms

$W_6(100) = (2 \times 0.02197) + (2 \times 0.02197) + 0.0356 + (10 \times 5) + (5 \times 0.0268) + (1 \times 11.93) = 62.18748 < 100$

Then, Load 2 Task is schedulable

So, System is schedulable