

Implementation Of EDF Scheduler

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Analytical Method Verification

1-System Hyper Period

Task	Periodicity (ms)
Button_1_Monitor	50
Button_1_Monitor	50
Transmitter	100
UART	20
Load_1	10
Load_2	100

Hyperperiod = Least common Multiplier of all Periods

= 100 ms

➔ That means all task or gannt chart repeats itself every 100ms

2- CPU Load

➔ We calculate execution time of every task from Keil simulator using Logic analyzer and cursor.

Task	Execution Time	Periodicity
Button_1_Monitor	13 μ s	50
Button_2_Monitor	13 μ s	50
Transmitter	17,3 μ s	100
UART	23,3 μ s	20
Load_1	5 ms	10
Load_2	12 ms	100

$$\begin{aligned}
 U &= \text{Total Exec. Time during one Hyper-Period} / \text{Hyper-Period} \\
 &= [(0.013 \times 2) + (0.013 \times 2) + (0.0173) + (0.0233 \times 5) + (5 \times 10) + (12)] / 100 \\
 &= 62.3415 \%
 \end{aligned}$$

2- Schedulability

Rating Monotonic Utilization Bound

$$U \leq n[2^{(1/n)} - 1] ; n \rightarrow \text{no. of Tasks}$$

$$URM = n[2^{(1/n)} - 1] = 6[2^{(1/6)} - 1] = 0.7347$$

$$U = \sum C / P = (0.013/50) + (0.013/50) + (0.0173/100) + (0.0233/20) + (0.05) + (0.12) = 0.621858$$

Since $U < URM$, So the system is indeed Schedulable.

Time Demand Analysis

Arrangement of Tasks would be.

1- Load 1 \rightarrow T1

2- UART \rightarrow T2

3- Button 1 \rightarrow T3

4- Button 2 \rightarrow T4

5- Transmitter \rightarrow T5

6- Load 2 \rightarrow T6

T1 Calculations

$$W(1) = 5 + 0 = 5\text{ms}$$

$$W(10) = 5 + 0 = 5\text{ms}$$

$$W(10) < D = 5\text{ms} < 10\text{ms} \rightarrow \text{T1 is Schedulable}$$

T2 Calculations

$$W(1) = 23.3\mu\text{s} + (1/10) * 5\text{ms} = 0.50233\text{ms}$$

$$W(5) = 23.3\mu\text{s} + (5/10) * 5\text{ms} = 2.5233\text{ms}$$

$$W(10) = 23.3\mu\text{s} + (10/10) * 5\text{ms} = 5.0233\text{ms}$$

$$W(20) = 23.3\mu\text{s} + (20/10) * 5\text{ms} = 10.0233\text{ms}$$

$$W(20) < 20\text{ms} \rightarrow \text{T2 is Schedulable}$$

T3 Calculations

$$W(1) = 13\mu\text{s} + (1/10) * 5\text{ms} + (1/20) * 23.3\mu\text{s} = 0.514165\text{ms}$$

$$W(50) = 13\mu\text{s} + (50/10) * 5\text{ms} + (50/20) * 23.3\mu\text{s} = 25.071\text{ms}$$

$$W(50) < 50\text{ms} \rightarrow \text{T3 is Schedulable}$$

T4 Calculations

$$W(50) = 13\mu\text{s} + (50/10) * 5\text{ms} + (50/20) * 23.3\mu\text{s} + (50/50) * 13\mu\text{s} = 25.084\text{ms}$$

$$W(50) < 50\text{ms} \rightarrow \text{T4 is Schedulable}$$

T5 Calculations

$$W(100) = 17.3\mu\text{s} + (100/50) * 13\mu\text{s} + (100/10) * 5\text{ms} + (100/20) * 23.3\mu\text{s} + (100/50) * 13\mu\text{s} = 50.1858\text{ms}$$

$$W(100) < 100\text{ms} \rightarrow \text{T5 is Schedulable}$$

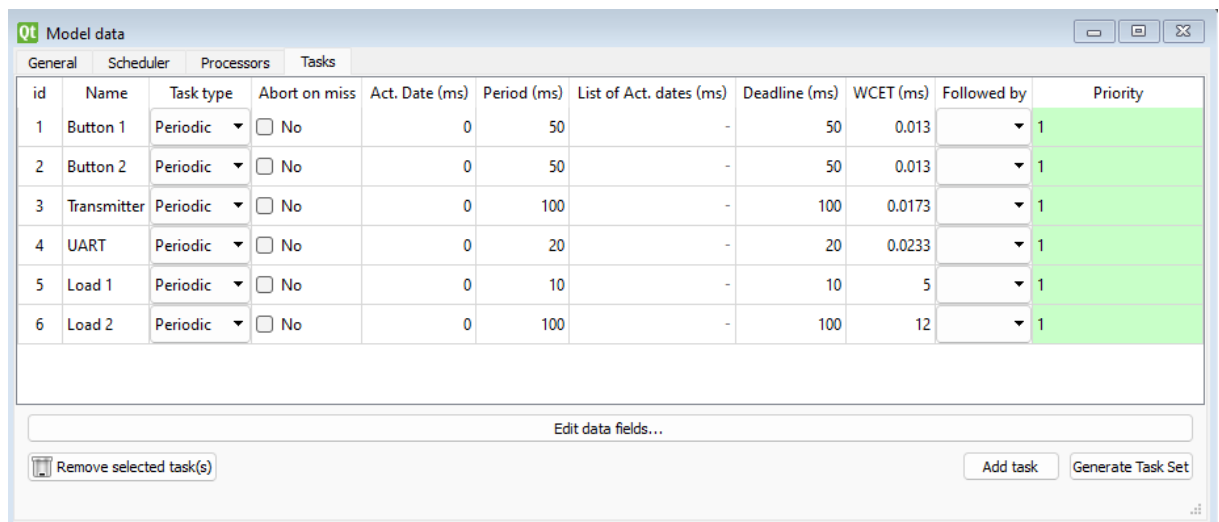
T6 Calculations

$$W(100) = 12\text{ms} + (100/100)17.3\mu\text{s} + (100/50) * 13\mu\text{s} + (100/10) * 5\text{ms} + (100/20) * 23.3\mu\text{s} + (100/50) * 13\mu\text{s} = 62.1858\text{ms}$$

$W(100) < 100\text{ms} \rightarrow \text{T6 is Schedulable}$

Simso offline Simulator

1- Task Creation \rightarrow Execution time extracted from Keil Simulator

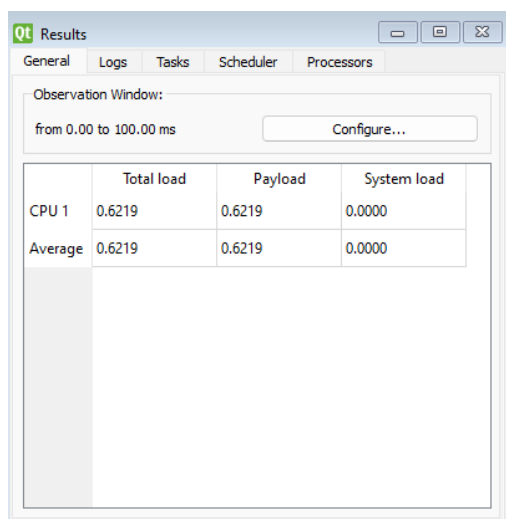


The screenshot shows the 'Qt Model data' window with the 'Tasks' tab selected. It contains a table with 11 columns: id, Name, Task type, Abort on miss, Act. Date (ms), Period (ms), List of Act. dates (ms), Deadline (ms), WCET (ms), Followed by, and Priority. There are 6 tasks listed, all with a priority of 1. The tasks are: Button 1, Button 2, Transmitter, UART, Load 1, and Load 2. Each task is periodic and has an abort on miss set to 'No'.

id	Name	Task type	Abort on miss	Act. Date (ms)	Period (ms)	List of Act. dates (ms)	Deadline (ms)	WCET (ms)	Followed by	Priority
1	Button 1	Periodic	<input type="checkbox"/> No	0	50	-	50	0.013		1
2	Button 2	Periodic	<input type="checkbox"/> No	0	50	-	50	0.013		1
3	Transmitter	Periodic	<input type="checkbox"/> No	0	100	-	100	0.0173		1
4	UART	Periodic	<input type="checkbox"/> No	0	20	-	20	0.0233		1
5	Load 1	Periodic	<input type="checkbox"/> No	0	10	-	10	5		1
6	Load 2	Periodic	<input type="checkbox"/> No	0	100	-	100	12		1

Below the table, there is an 'Edit data fields...' button and a 'Remove selected task(s)' button. At the bottom right, there are 'Add task' and 'Generate Task Set' buttons.

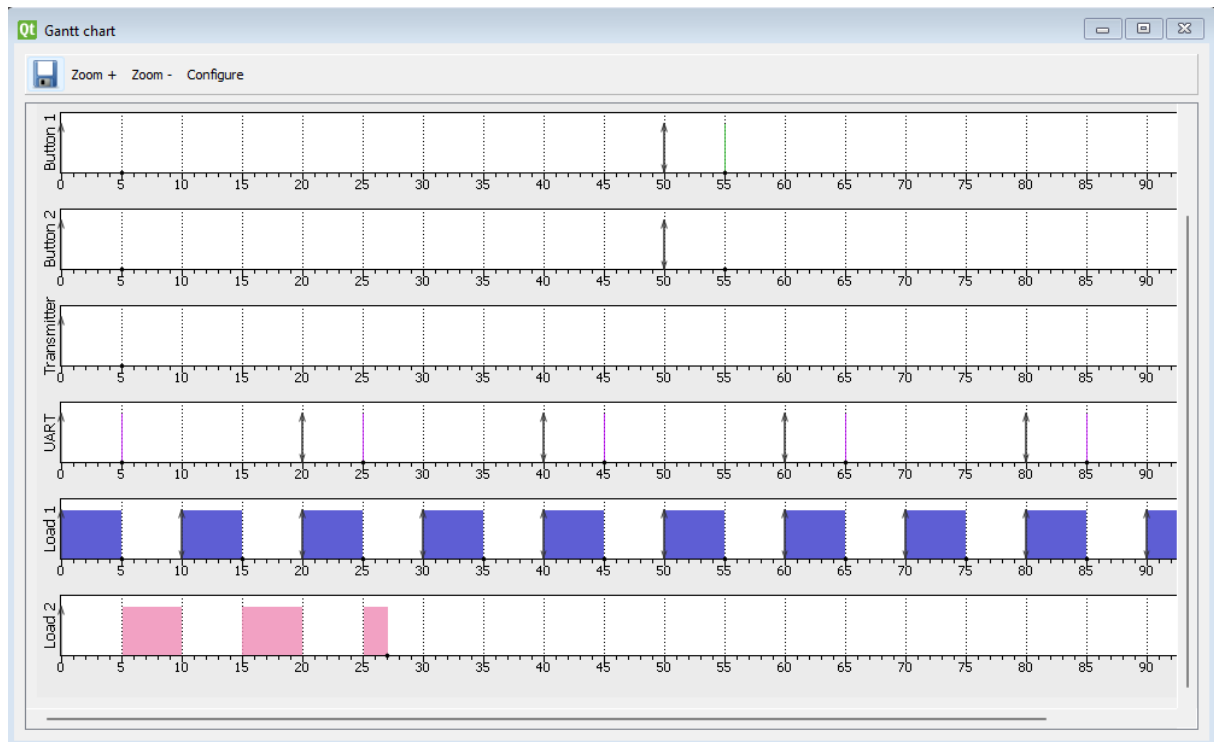
2- Calculating CPU Load



The screenshot shows the 'Qt Results' window with the 'General' tab selected. It displays the 'Observation Window' from 0.00 to 100.00 ms. Below this, there is a table showing the CPU load calculation for CPU 1 and the average.

	Total load	Payload	System load
CPU 1	0.6219	0.6219	0.0000
Average	0.6219	0.6219	0.0000

3- Gantt Chart and noticing if any task miss it's Deadline

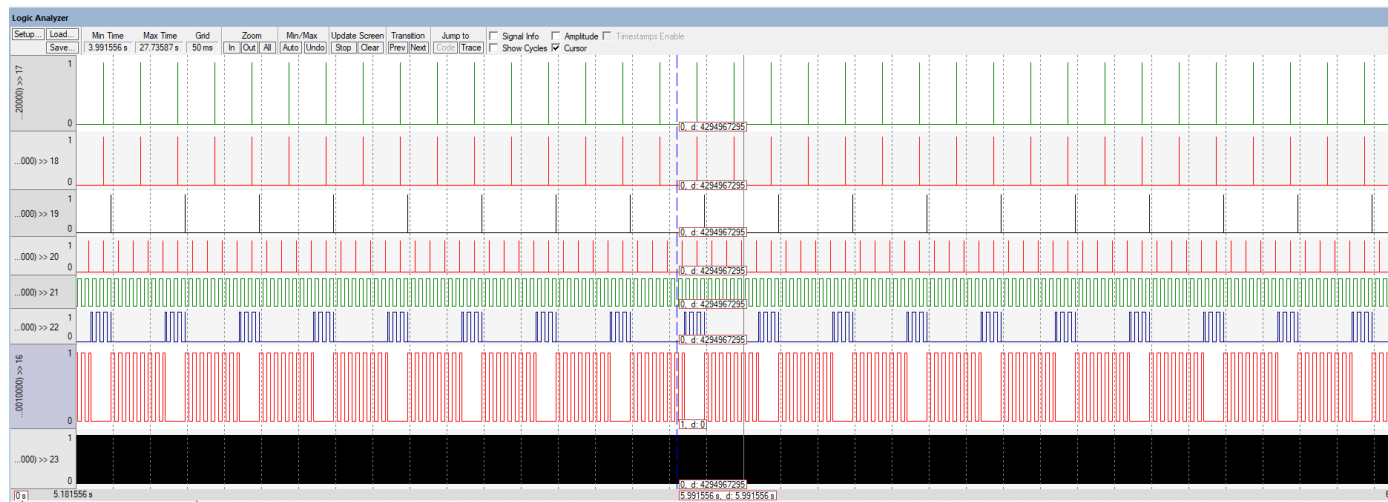


Keil Simulator

1-CPU Load

Watch 1		
Name	Value	Type
Button1_TaskTotalTime	1454	int
Button2_TaskTotalTime	1464	int
Periodic_TaskTotalTime	1314	int
UART_TaskTotalTime	2575	int
Load1_TaskTotalTime	838367	int
Load2_TaskTotalTime	201469	int
System_Time	1662301	int
CPU_Load	62	int
<Enter expression>		

2-Using Logic Analyzer and Trace Hooks



System is schedulable with 62~63% CPU_Load and EDF scheduler is successfully implemented.