

# **FWD Advanced Embedded Track**

## **Project 2**

### **EDF Scheduler implementation in freeRTOS**

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Execution time for each task was calculated using Keil logic Anaslyzer an obtained as follows:

Task Name	Periodicity (Tick)	Deadline (Tick)	Execution Time (ms)
T1_Button1	50	50	0.014
T2_Button2	50	50	0.014
T3_PeriodicString	100	100	0.102
T4_UART_Print	20	20	0.105
T5_Load1	10	10	5
T6_Load2	100	100	12

Note that load tasks execution time was calculated as follows to meet rubric criteria:

```

/* From LogicAnalyzer:- It takes 1.006317ms to create 10000 loop Load Task
 * So one loop takes 0.0001006317ms
 * So to execute 5ms we need ~ (5ms / 0.0001006317ms) = 49686 loops
 */
/* From LogicAnalyzer:- It takes 1.006317ms to create 10000 loop Load Task
 * So one loop takes 0.0001006317ms
 * So to execute 12ms we need ~ (12ms / 0.0001006317ms) = 119246 loops
 */

```

## Requirements:

- 1- Hyper Period
- 2- CPU load
- 3- Check system Schedualbility using URM and TD analysis.
- 4- Apply analysis in SimSo
- 5- Apply Analysis in Keil Logic Analyzer

## Solution:

**(1)** Hyper period: least common divisor of all tasks periodicity => **100**

**(2)** CPU Load =  $\frac{\text{Tasks execution time}}{\text{Hyper Period}} =$   

$$\frac{\left(\frac{100}{50} \times 0.014\right) + \left(\frac{100}{50} \times 0.014\right) + \left(\frac{100}{100} \times 0.102\right) + \left(\frac{100}{20} \times 0.105\right) + \left(\frac{100}{10} \times 5\right) + \left(\frac{100}{100} \times 12\right)}{100} = 0.62683 = \mathbf{62.6\%}$$

**(3)**

$$URM = n \left( 2^{\frac{1}{n}} - 1 \right) = 6 \times \left( 2^{\frac{1}{6}} - 1 \right) = 0.7347 \text{ ,, } 0.62683 < 0.7347 \rightarrow \mathbf{\text{System is Schedulable}}$$

using Time Demand Analysis:

Sorting Tasks as follows according to deadline (priority in EDF):

Task Name	Periodicity (Tick)	Deadline (Tick)	Execution Time (ms)
T5_Load1	10	10	5
T4_UART_Print	20	20	0.105
T1_Button1	50	50	0.014
T2_Button2	50	50	0.014
T6_Load2	100	100	12
T3_PeriodicString	100	100	0.102

Calculations :

- 1) **Task5:-**  $Tick(1) \rightarrow Tick(5) \therefore = 5 \text{ ms}$
- 2) **Task4:-**  $Tick(1) \rightarrow Tick(20) \therefore = 0.105 + (2 \times 5) = 10.105 \text{ ms}$
- 3) **Task1:-**  $Tick(1) \rightarrow Tick(50) \therefore = (0.014) + (2 \times 0.105) + (5 \times 5) = 25.224 \text{ ms}$
- 4) **Task2:-**  $Tick(1) \rightarrow Tick(50) \therefore = (0.014) + (0.014) + (2 \times 0.105) + (5 \times 5) = 25.238 \text{ ms}$
- 5) **Task6:-**  $Tick(1) \rightarrow Tick(100) \therefore = (1 \times 12) + (2 \times 0.014) + (2 \times 0.014) + (5 \times 0.105) + (10 \times 5) = 62.581 \text{ ms}$
- 6) **Task3:-**  $Tick(1) \rightarrow Tick(100) \therefore = (0.102) + (1 \times 12) + (2 \times 0.014) + (2 \times 0.014) + (5 \times 0.105) + (10 \times 5) = 62.683 \text{ ms}$

*62.683 is less than Task3 deadline, So system is Schedulable*

(4)

Qt Model data

General Scheduler Processors Tasks

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	T1_Button1	Periodic	<input type="checkbox"/> No	0.0	50.0	-	50.0	0.014	▼	1
2	T2_Button2	Periodic	<input type="checkbox"/> No	0.0	50.0	-	50.0	0.014	▼	1
3	T3_PeriodicString	Periodic	<input type="checkbox"/> No	0.0	100.0	-	100.0	0.102	▼	1
4	T4_UART_Print	Periodic	<input type="checkbox"/> No	0.0	20.0	-	20.0	0.105	▼	1
5	T5_Load1	Periodic	<input type="checkbox"/> No	0.0	10.0	-	10.0	5.0	▼	1
6	T6_Load2	Periodic	<input type="checkbox"/> No	0.0	100.0	-	100.0	12.0	▼	1

Edit data fields...

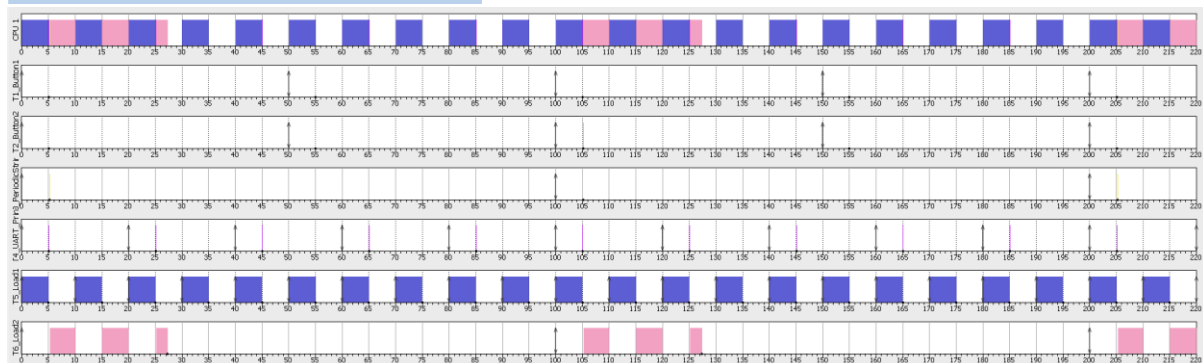
Remove selected task(s) Add task Generate Task Set

Qt Results

General Logs Tasks Scheduler Processors

Observation Window:  
from 0.00 to 1000.00 ms Configure...

	Total load	Payload	System load
CPU 1	0.6268	0.6268	0.0000
Average	0.6268	0.6268	0.0000



(5)

#### Watch 1

Name	Value	Type
CPU_Load	62	uint
SysTime	2754424	uint
T1_Total	1813	uint
T2_Total	1832	uint
T3_Total	3860	uint
T4_Total	3809	uint
T5_Total	1381340	uint
T6_Total	333338	uint

