Real-time operating systems project

Implementing EDF scheduler based on FREE RTOS

Analytical Calculations: -

Task	Task Period (ms)	Execution Time (ms)
Button 1	50	0.013
Button 2	50	0.013
Periodic Transmitter	100	0.018
UART Receiver	20	0.015
Load 1 Simulation	10	5
Load 2 Simulation	100	12

1. System Hyper Period = 100 ms.
2. $CPU = (\sum \lceil Task\ Execution\ Time \rceil)/(\sum \lceil Task\ Period \rceil)$

$$13/50000 + 13/50000 + 18/100000 + 15/20000 + 5000/10000 + 12000/100000$$

= 62.14 %

3. System Schedulability

- Urm Analysis:

  URM = n [$2^{1/n}$ – 1] = 0.7347

  ∵ U < URM.

  ∴ System is Schedulable.

4. Time Demand Analysis

Task	Task Priority (RM)	Task Period (ms)	Execution Time (ms)
Load 1 Simulation	4	10	5
UART Receiver	3	20	0.015
Button 1	2	50	0.013
Button 2	2	50	0.013
Periodic Transmitter	1	100	0.018
Load 2 Simulation	1	100	12

Time demand Analysis Equation: - $W_i(t) = e_i + \sum_{k=1}^{i-1} \left(\frac{t}{P_k}\right) e_k$

- Load 1 Simulation Task: -

  W_1 (10) = 5, p = 10

  W_1 (10) < P = 5 < 10, Load 1 Task is Schedulable.

- UART Receiver Task: -

  W_2 (20) = 0.015, P = 20

  $W_2(20) = 0.015 + \frac{20}{10} * 5 = 10.015$

  W_2 (20) <P = 10.015<20, UART Receiver Task is Schedulable.

- Button 1 Task: -

  W_3 (50) = 0.013, P = 50

  $W_3(50) = 0.013 + \left(\frac{50}{20}\right) * 0.015 + \left(\frac{50}{10}\right) * 5 = 25.0505$

  W_3 (50) <P = 25.0505, Button 1 Task is Schedulable.

- Button 2 Task: -

  W_4 (50) = 0.013, P = 50

  $W_4(50) = 0.013 + \left(\frac{50}{50}\right) * 0.013 + \left(\frac{50}{20}\right) * 0.015 + \left(\frac{50}{10}\right) * 5 = 25.0635$

  W_4 (50) <P = 25.0635, Button 2 Task is Schedulable.

- Periodic Transmitter Task: -

  W_5 (100) = 0.018, P = 100

  $W_5(100) = 0.018 + \left(\frac{100}{50}\right) * 0.013 + \left(\frac{100}{50}\right) * 0.013 + \left(\frac{100}{20}\right) * 0.015 + \left(\frac{100}{10}\right) * 5 = 50.145$

  W_5 (100) <P = 50.145, Periodic Transmitter Task is Schedulable.

- Load 2 Simulation Task: -

$W_6(100) = 12$, $P = 100$

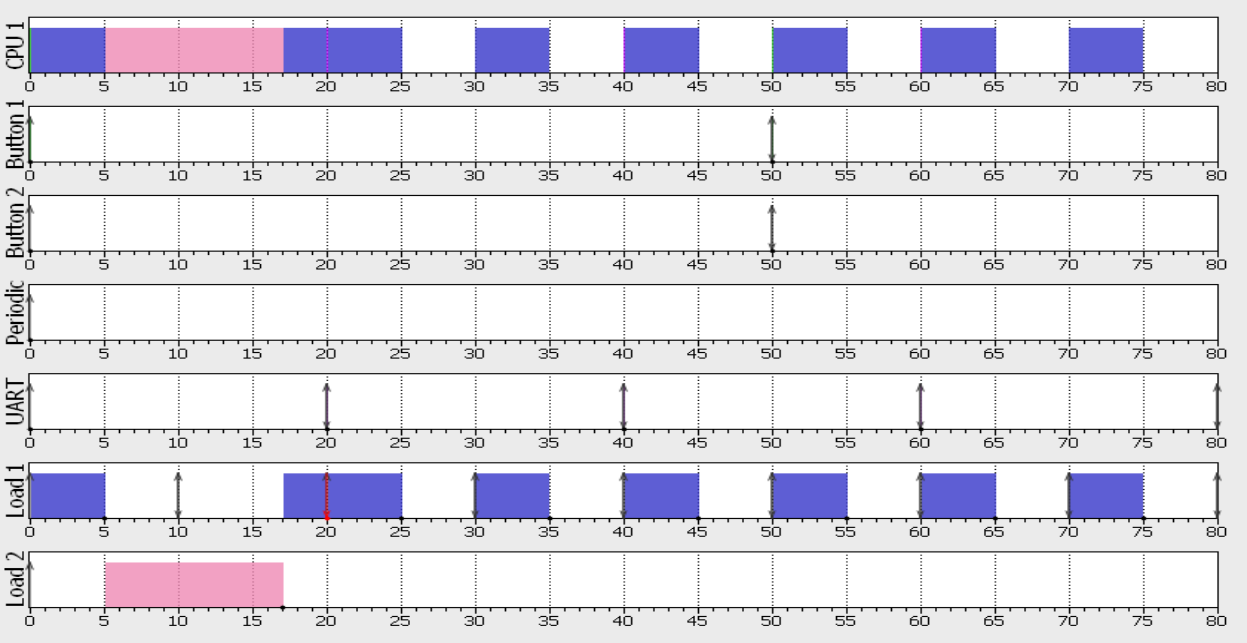
$$W_6(100) = 12 + 0.018 + \left(\frac{100}{50}\right) * 0.013 + \left(\frac{100}{50}\right) * 0.013 + \left(\frac{100}{20}\right) * 0.015 + \left(\frac{100}{10}\right) * 5 = 62.145$$

$W_6(100) < P = 62.145$, Load 2 Simulation Task is Schedulable.

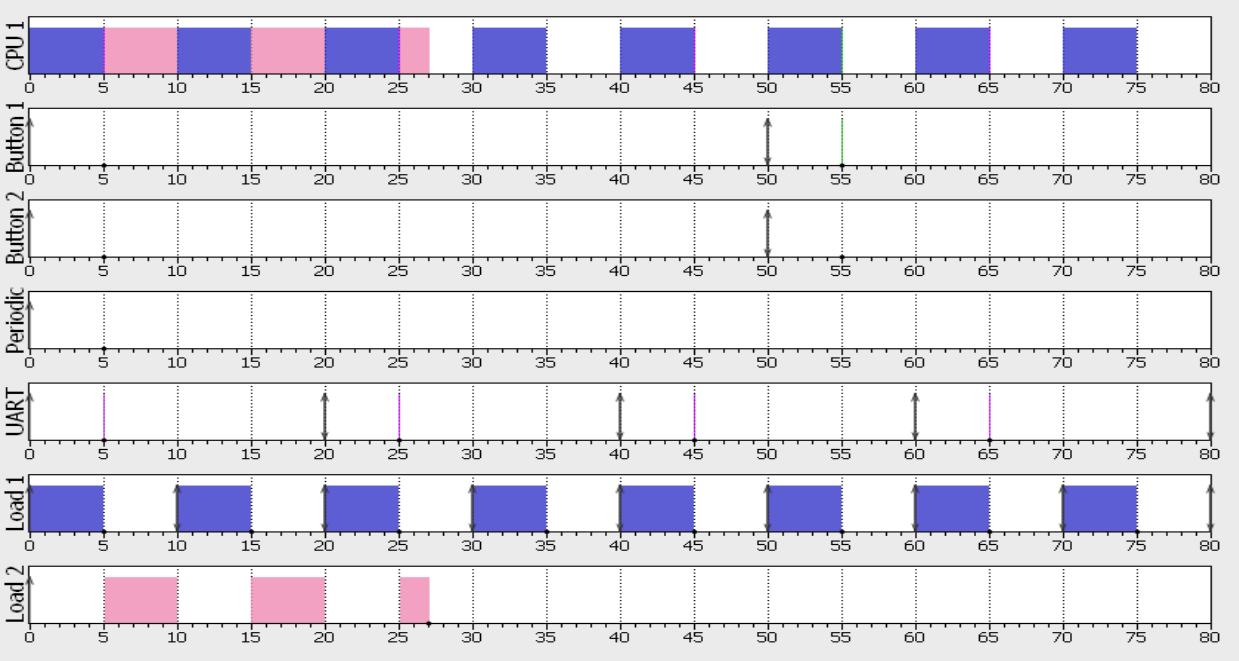
∴ System is Schedulable.

Simso Offline Simulator: -

- Fixed Priority Rate Monotonic Schedule.



- EDF Schedule.



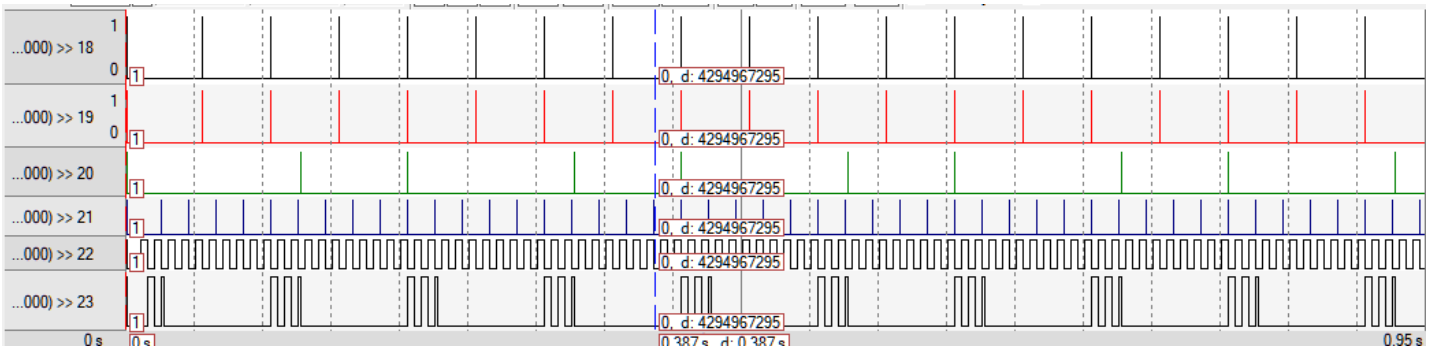
Keil Simulation: -

1. CPU load and time.

Name	Value
Task_1_Total_Time	405
Task_2_Total_Time	412
Task_3_Total_Time	383
Task_4_Total_Time	615
Task_5_Total_Time	166624
Task_6_Total_Time	40151
System_Time	331790
CPU_Load	62
<Enter expression>	

2. Logic Analyzer.

- Signal 1: - Button 1 Task.
- Signal 2: - Button 2 Task.
- Signal 3: - Period Transmitter Task.
- Signal 4: - UART Receiver Task.
- Signal 5: - Load 1 Simulation Task.
- Signal 6: - Load 2 Simulation Task.



Results of all analysis are as expected and matches the manual analytical calculations