Real Time Operating System Project

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Analytical Calculations

1. **Hyperperiod**

   Hyperperiod = LCM (Tasks periods)

   = LCM (50, 50, 100, 100, 10, 100)

   = 100

2. CPU Execution Time

- Button 1 Monitor

  The execution time is 18 us.

- Button 2 Monitor

  The execution time is 18 us.

- Periodic Transmitter

  The execution time is 22 us.

- Uart Receiver

  The execution time is 40 us.

- Load 1 Simulation

  The execution time is 5 ms.

- Load 2 Simulation

  The execution time is 12 ms.

Utililzation = Total_Execution_Time_In_Hyperperiod / Hyperperiod

$$= \frac{(0.018*2+0.018*2+0.022+0.04+5*10+12)}{100} \times 100 = 62.134\%$$

2. System Schedulability

- **Is the system schedulable?**

1. RMU Schedulability Bound

The system is schedulable if $U \leq n\left(2^{\frac{1}{n}} - 1\right)$

In the system U = 62.134% and U_{rm} = 74.48 % So, U < U_{rm} Then the system is schedulable.

2. Time Demand

$$wi(t) = ei + \sum_{k=1}^{i-1} \left\lceil \frac{t}{p_k} \right\rceil e_k \quad for\ 0 < t \leq pi$$

Where:

wi is the processor time demand.

p_k is the periodicity of task k

e_k is the execution time of task k for all higher priority tasks

1. for load 1 simulation (the task with the highest priority)

wi = 5ms + 0 = 5ms < 10ms (task deadline) then task is schedulable

2. for Button 1 monitor

wi = 0.018 + $\frac{50}{10} \times 5$ = 22.518 < 50ms (task deadline) then the task is schedulable

3. for Button 2 monitor

wi = 0.018 + $\frac{50}{10} \times 5 + \frac{50}{50} \times 0.018$ = 22.536ms < 50ms (task deadline) then the task is schedulable

4. for periodic transmitter

wi = 0.022 + $\frac{100}{10} \times 5 + \frac{100}{50} \times 0.018 + \frac{100}{50} \times 0.018$ = 50.094 < 100ms (task deadline)

Then the task is schedulable

5. for uart receiver

wi = 0.04 + $\frac{100}{10} \times 5 + \frac{100}{50} \times 0.018 + \frac{100}{50} \times 0.018 + \frac{100}{100} \times 0.022$ = 50.134 < 100ms (task deadline) then the task is schedulable.

6. for load 2 simulation

wi = 12 + $\frac{100}{10} \times 5 + \frac{100}{50} \times 0.018 + \frac{100}{50} \times 0.018 + \frac{100}{100} \times 0.022 + \frac{100}{100} \times 0.04$

= 62.134 < 100ms (task deadline) then the task is schedulable.

Keil Simulation

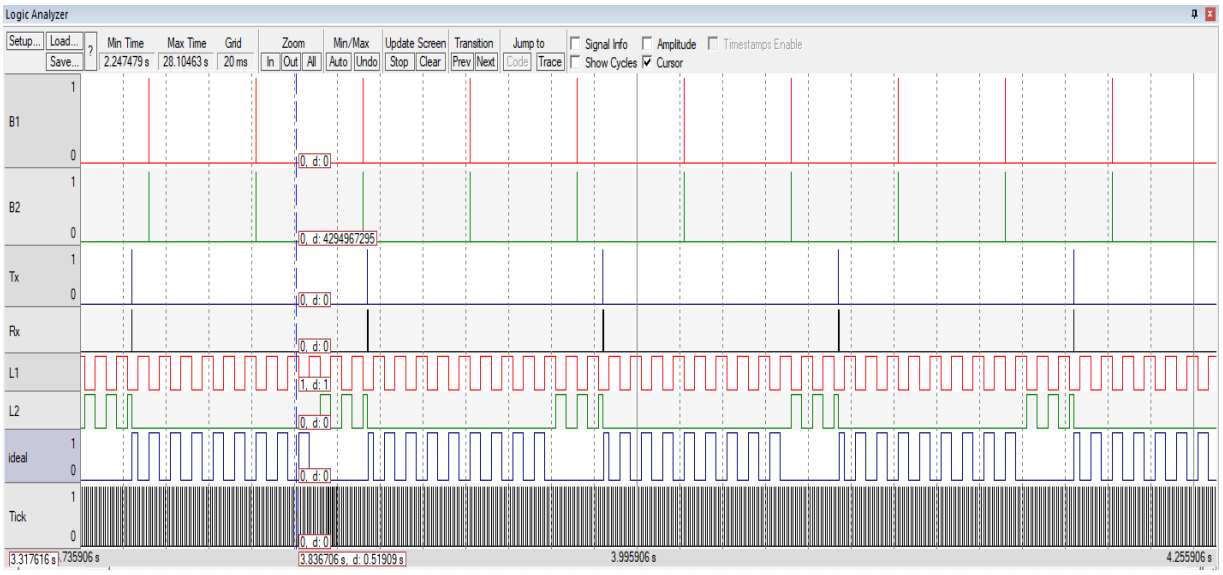
- **Calculation of cpu total execution time and cpu load using timer 1**

Watch 1

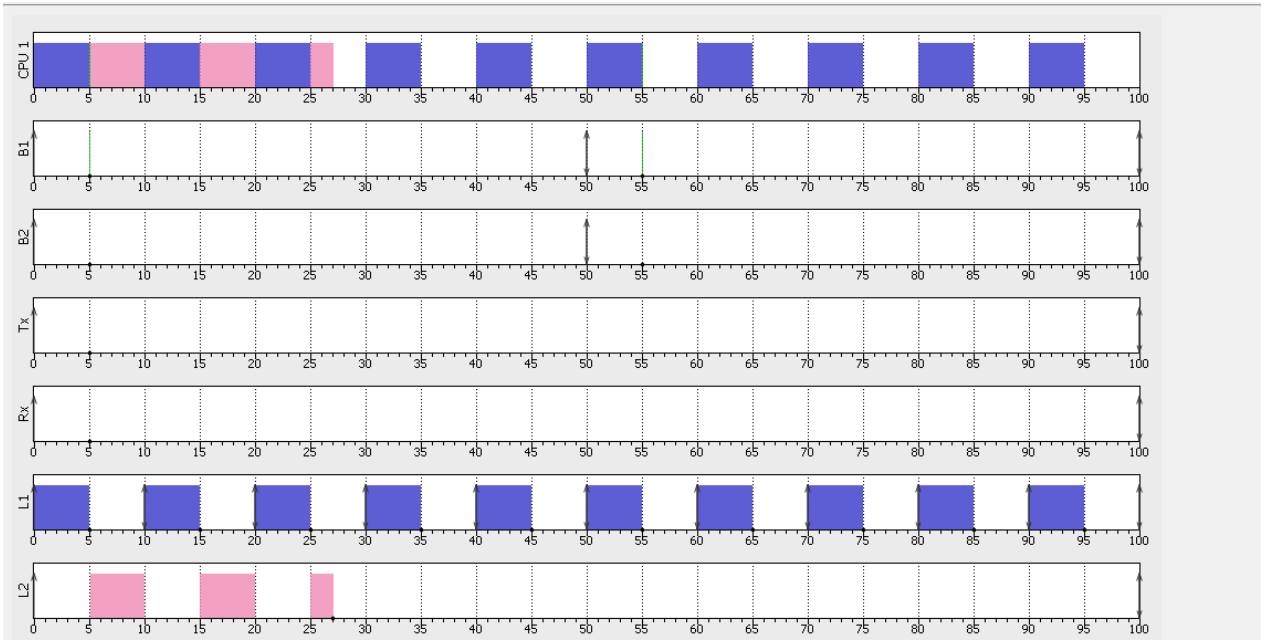
Name	Value	Type
totalExection	0x000FD104	uint
cpuLoad	0x0000003D	uint
T1TC	0x0019B462	ulong
totalB1	0x00000265	uint
totalB2	0x00000276	uint
totalTx	0x0000015C	uint
totalRx	0x0000026B	uint
totalL1	0x000CF355	uint
totalL2	0x0002D59B	uint
<Enter expression>		

The figure here shows the total execution time for each task and total cpu execution time during the T1TC period.

- Plotting all tasks and tick using logic analyzer



Simso Simulation



Conclusion

- **The system is feasible and schedulable as shown from analytical calculations and keil simulation.**
- **The analytical calculations and simulation calculations are similar.**
- **We can notice that tasks don’t miss their deadlines.**