Sprints

RTOS

Health Care System Design

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Overview

An RTOS design for a healthcare system that includes:

- A touch LCD as input that can control the system and give commands. Every LCD command is represented in 4 bytes. LCD is connected to the micro-controller through UART with speed 9600 bps [Bit per second]. (Reading 4 bytes and processing the command takes 2 ms).

- Blood pressure sensor with new data every 25ms. (Reading the sensor and processing its data takes 3 ms).

- Heart beat detector with new data every 100ms. (Reading the sensor and processing its data takes 1.5 ms).

- Temperature sensor with new data every 10ms. (Reading the sensor and processing its data takes 2.5 ms).

- Alert siren. (Activate or Deactivate the siren takes 1 ms)

Preliminary Design

System Tasks

The system is divided into ***five*** tasks:

- One task is to communicate with the LCD. (periodicity: 100 ms)
- One task is to read and process the BP sensor data. (periodicity: 10 ms)
- One task is to read and process the heart beat detector data. (periodicity: 50 ms)
- One task is to read the temperature sensor data. (periodicity: 10 ms)
- One task is to activate/deactivate an alert siren. (sporadic)

  Where :

  - Each task's deadline is the same as its periodicity.
  - Task priorities are assigned according to rate monotonic scheduling i.e. according to their periodicities.
  - The periodicity for the task reading the temperature sensor is 10 ms so the task would not be able to get every reading that the sensor registers (according to Nyquist Criterion). This is done here as it is not crucial for human beings to have their temperature taken at a very high rate. Otherwise all other tasks' periodicities conform with the Nyquist Criterion.

System Parameters

System Tick Rate

At worst case (all tasks ready at the same tick):

$$Task\ Execution\ time\ =\ 3\ +\ 2\ +\ 1.5\ +\ 2.5\ +\ 1\ =\ 10\ ms$$

So, in this design the system tick would be generated every ***10 ms*** to accommodate all tasks while also satisfying the task periodicities.

Hyper Period

$$Hyper\ period\ =\ LCM(All\ task\ periodicities)\ =\ LCM(10,\ 50,\ 100)\ =\ 100\ ms$$

CPU Load

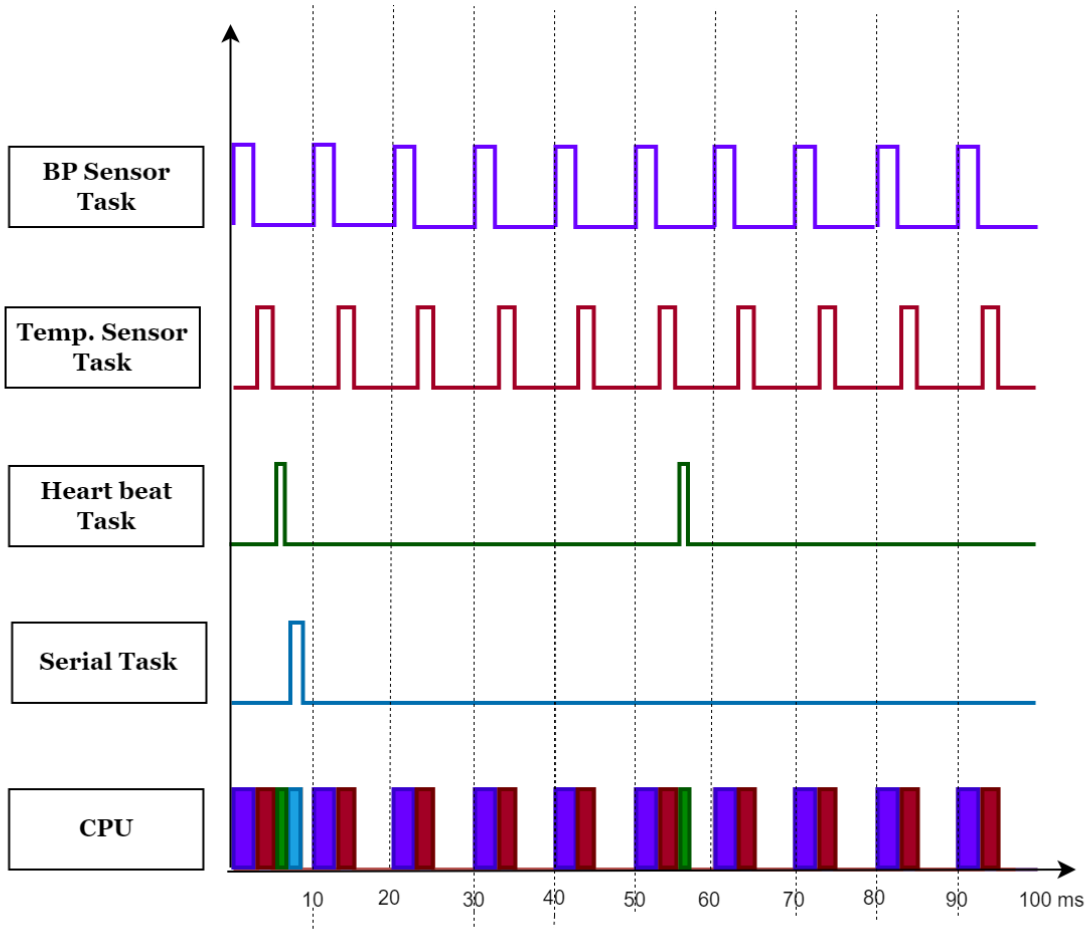
For periodic tasks :

$$CPU\ Load\ =\frac{\frac{100}{10}*3+2+\frac{100}{50}*1.5+\frac{100}{10}*2.5}{100}=\ 0.6$$

(CPU load = 60%)

For all tasks, including sporadic tasks (alarm), CPU load = 61%

System Timeline



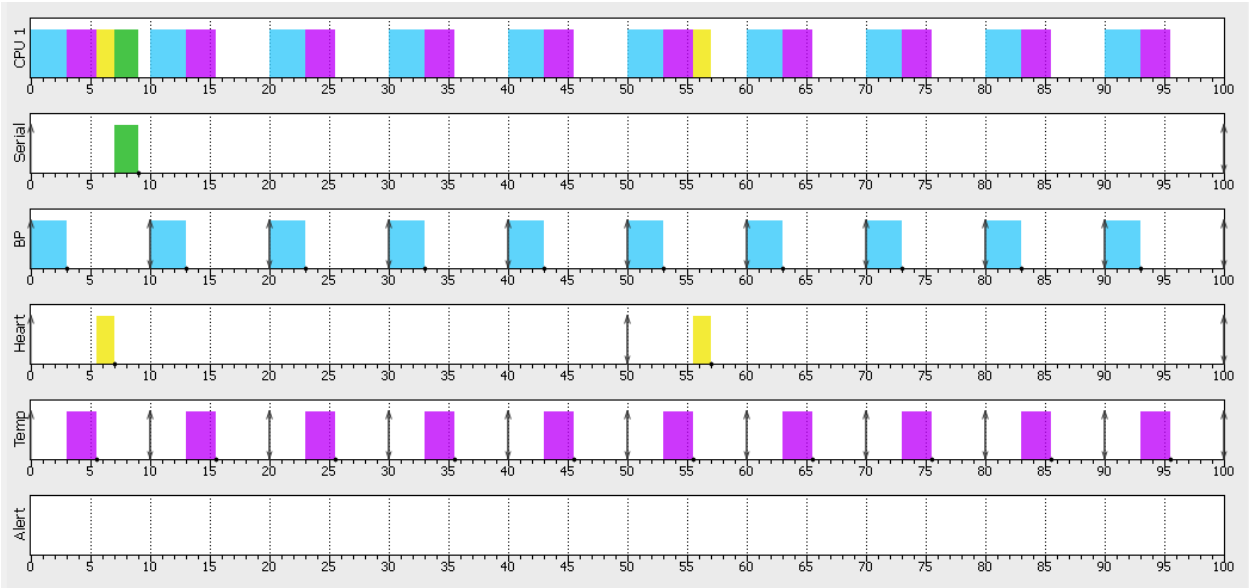
From the timeline, all the tasks will execute according to their assigned priorities without preemption throughout the hyperperiod.

SimSo System Model

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	Serial	Periodic	☑ Yes	0	100	-	100	2		0
2	BP	Periodic	☑ Yes	0	10	-	10	3		0
3	Heart	Periodic	☑ Yes	0	50	-	50	1.5		0
4	Temp	Periodic	☑ Yes	0	10	-	10	2.5		0
5	Alert	Sporadic	☑ Yes	-	-		2	1.0		0

Results



The results match the results manually calculated above and all the scheduled tasks meet their deadlines.

Observation Window:

from 0.00 to 100.00 ms | Configure...

	Total load	Payload	System load
CPU 1	0.6000	0.6000	0.0000
Average	0.6000	0.6000	0.0000