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Healthcare System Design

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SPRINTS

Contents

HEALTHCARE SYSTEM DESIGN

1. INTRODUCTION

This document will be analyzing a design for a healthcare system using RTOS

1.1. Requirements

- 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 microcontroller through UART with a speed of 9600 bps [Bit per second]. (Reading 4 bytes and processing the command takes 2ms)
- Blood pressure sensor with new data every 25ms. (Reading the sensor and processing its data takes 3ms)
- Heartbeat detector with new data every 100ms. (Reading the sensor and processing takes 1.5ms)
- Temperature sensor with new data every 10ms. (Reading the sensor and processing takes 2.5ms)
- Alert siren. (Activate or deactivate the siren takes 1ms)

2. TASKS

Task Name	Priority	Periodicity	Execution Time	Deadline
Display	1	100	2	100
Blood pressure	4	10	3	10
Heartbeat	3	50	1.5	50
Temperature	4	10	2.5	10
Alert	2	10	1	10

- So, regarding tasks, I'm assuming that LCD and UART is one task as you mentioned that reading 4 bytes and processing the command takes 2ms, however, if we calculate it sending 4 bytes using 9600 bps assuming the UART frame is 12 bits, it will take around 5ms to send 4 bytes through it. So, I neglected this part and assumed the process takes 2ms as you mentioned.
- Blood pressure sensor, reads every 25ms so for catching every read it has to be more than double its regular speed, I choose getting a read every 10ms to unite the tick rate to 10ms if I choose it to be 12ms I'll have to change the tick rate to 2ms which will make the system loaded, its priority is the highest because it has the highest periodicity
- Heartbeat sensor, reads every 100ms so I choose the periodicity to be 50ms and its priority is the second because its periodicity in sensors is the second

- Temperature sensor, I choose the same periodicity as it's not risky as to heartbeat and blood pressure risks however its periodicity is 10ms which is too high for the healthcare system. Its priority is the same as the blood pressure sensor too because both sensors have the same periodicity.
- Alert sensor however it's high periodicity as the temperature sensor and blood pressure sensor, I choose to be the third in the priority as if any of those three sensors is above/below the normal range will directly notify the alert in case we are not using event groups.

2.1. Tick Rate

Now we have 5 tasks and as all the tasks are dividable by 10, so **I'll choose the tick rate to be every 10ms.**

2.2. Calculations

2.2.1. Hyper period

The hyper period will be = 100ms as it's the least common multiple of all tasks.

2.2.2. CPU load

$$U = \frac{R}{C}$$

U = Utilization

R = Requirements which in simple terms is the Busy Time

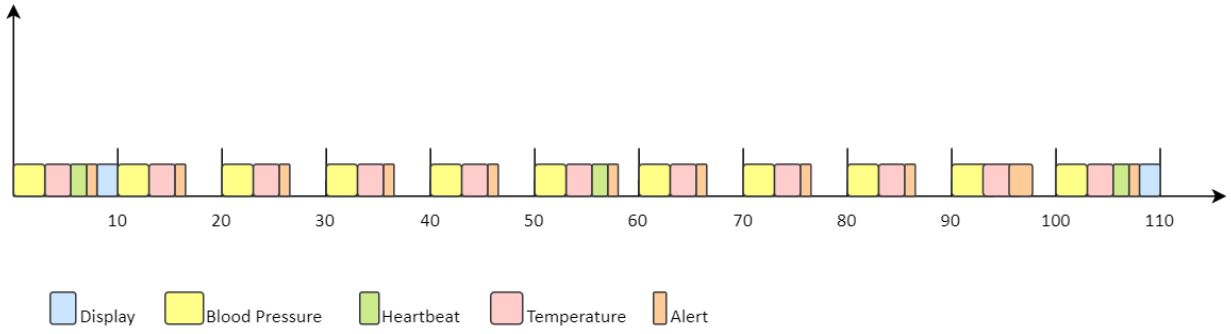
C = Capacity which in simple terms is Busy Time + Idle Time

So, $U = \frac{2}{100} + \frac{3}{10} + \frac{1.5}{50} + \frac{2.5}{10} + \frac{1}{10} = 0.7$

Conclusion: The system is unloaded

2.3. Timeline Analysis

2.3.1. Manual



Conclusion: The system is schedulable as there is not any task that misses its deadline, and at the hyper periods the time taken by the five tasks is 10ms seconds which is equal to system tick time.

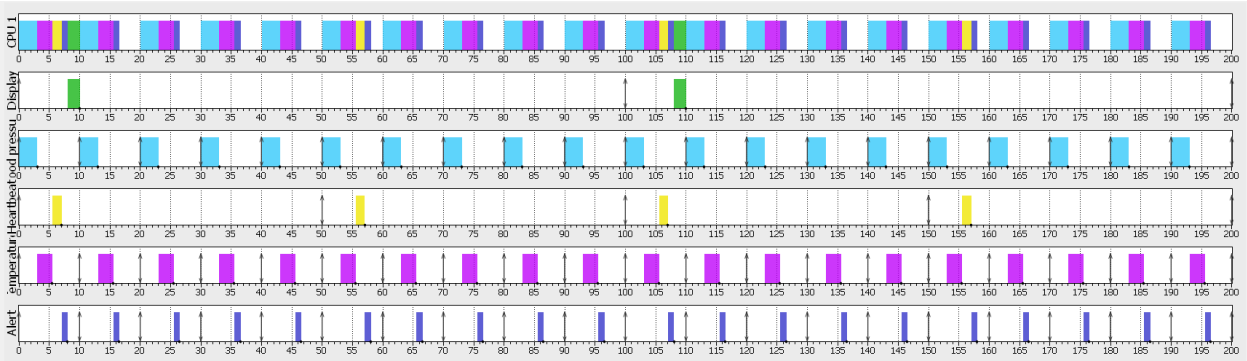
2.3.2. Simso

2.3.2.1. Model Data

Duration (cycles)	2000
Duration (ms)	200
Cycles / ms	10
Execution Time Model	WCET

id	Name	Task type	Abort on miss	Act. Date (ms)	Period (ms)	List of Act. dates (ms)	Deadline (ms)	WCET (ms)	owec	priority
1	Display	Periodic	Yes	0	100	-	100	2		1
2	Blood pressure	Periodic	Yes	0	10	-	10	3		4
3	Heartbeat	Periodic	Yes	0	50	-	50	1.5		3
4	Temperature	Periodic	Yes	0	10	-	10	2.5		4
5	Alert	Periodic	Yes	0	10	-	10	1		2

2.3.2.2. Gantt Chart



2.3.2.3. Program's Results

	Total load	Payload	System load
CPU 1	0.7000	0.7000	0.0000
Average	0.7000	0.7000	0.0000

2.3.2.4. Conculision

CPU load is 70% which means the system is not loaded.

According to Gantt Chart all tasks are schedulable and there is not any task misses its deadline.