

DESIGNING A REAL TIME SYSTEM

Prepared by:

Amr El-Abd

1-Number of tasks:

There are (5) tasks in the system which are:

- 1- Display LCD task
- 2- Blood pressure sensor task
- 3- Heartbeat sensor task
- 4- Temperature sensor task
- 5- Alert siren task

2-Task parameters:

Task name	Priority	Periodicity (ms)	Deadline (ms)
Display LCD task	1	100	100
Blood pressure sensor task	2	12.5	12.5
Heartbeat sensor task	2	50	50
Temperature sensor task	2	10	10
Alert siren task	3	10	10

The screenshot shows the 'Qt Model data' window with the 'Tasks' tab selected. The table below represents the data shown in the window:

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	Display LCD	Periodic	<input checked="" type="checkbox"/> Yes	0	100	-	100	2	1	1
2	Blood pressure sensor	Periodic	<input checked="" type="checkbox"/> Yes	0	12.5	-	12.5	3	2	2
3	Heart beat sensor	Periodic	<input checked="" type="checkbox"/> Yes	0	50	-	50	1.5	2	2
4	Temperature sensor	Periodic	<input checked="" type="checkbox"/> Yes	0	10	-	10	2.5	2	2
5	Alert siren	Periodic	<input checked="" type="checkbox"/> Yes	0	10	-	10	1	3	3

Below the table, there is an 'Edit data fields...' button. At the bottom, there are three buttons: 'Remove selected task(s)', 'Add task', and 'Generate Task Set'.

Comments on priority choice:

- LCD is the least critical task in the system, so it takes the least priority.
- All the sensors are equally important, so they take the same priority.
- Alert siren is the most important as it contains the logic for comparing the critical ranges for the sensor readings, so it takes the highest priority.

Comments on periodicity choice:

- The refresh rate for the LCD is 100 ms which is far less than what the human eye can detect.
- Heartbeat detector and blood pressure sensors get the frequency of double the refresh rate of the sensors, so their periodicity is half their refresh rate in order to make sure they never miss a reading.
- Temperature sensor isn't as critical as the other two sensors in addition to its high rate, so it has a periodicity equivalent to its refresh rate to .
- The alert siren has the periodicity equivalent to that of the least task so it can monitor any new change within the system.

3-System tick rate:

Since the total execution time for the tasks is 10 ms so I decided the system tick will be **10 ms** to make sure each task has completed its execution before the next tick occurs.

4-Hyperperiod calculation:

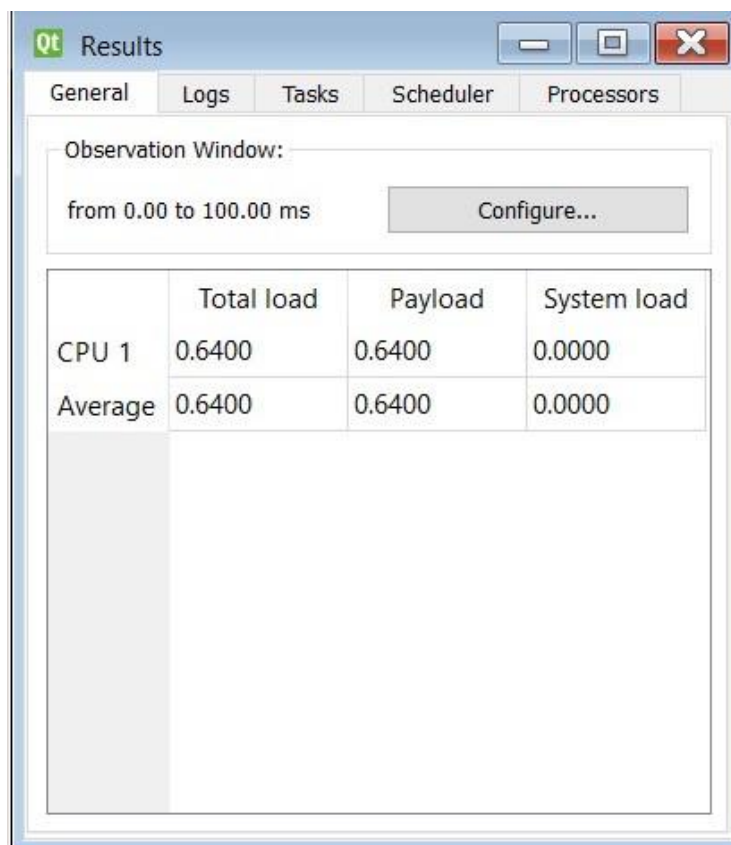
Hyperperiod is the lowest common multiple for the tasks periodicities so it will be **100 ms.**

5- CPU Load calculation:

$$\begin{aligned}\text{Requirements (R)} &= (2 + (8*3) + (1.5*2) + (2.5*10) + (1*10)) \\ &= 64 \text{ ms}\end{aligned}$$

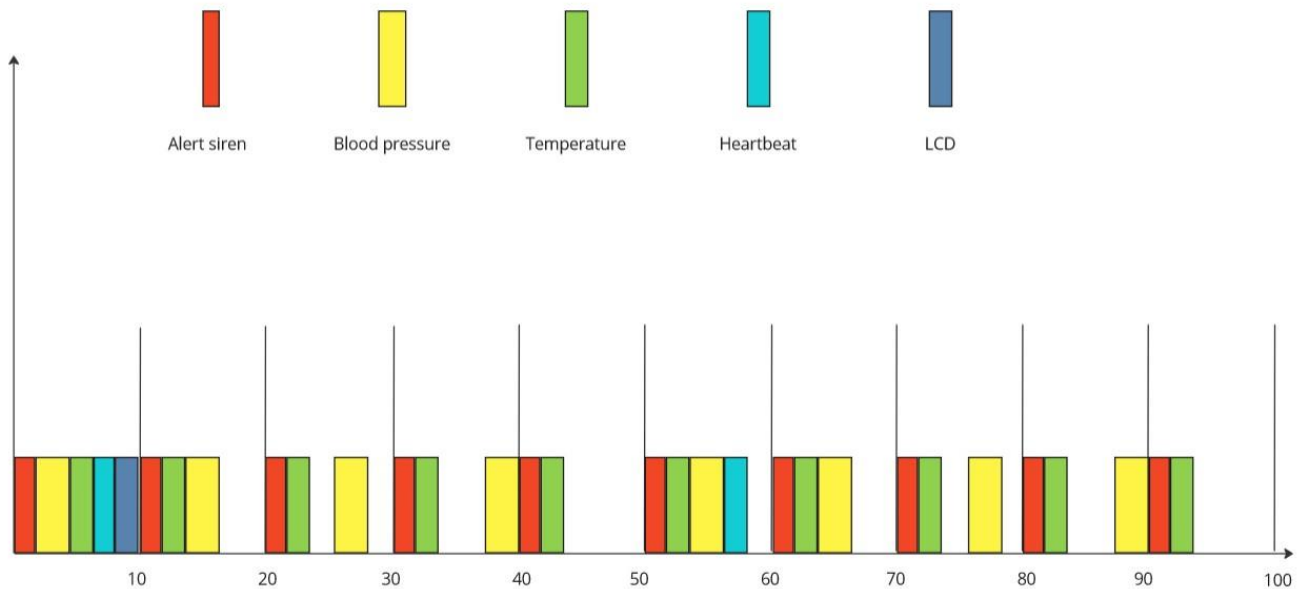
$$\text{Capacity (C)} = 100 \text{ ms}$$

$$\begin{aligned}\text{Utilization (U)} &= (\text{R}) / (\text{C}) \\ &= 64 / 100 = 0.64 \text{ (64\%)}\end{aligned}$$

The image shows a screenshot of a Qt application window titled "Results". It has a tabbed interface with tabs for "General", "Logs", "Tasks", "Scheduler", and "Processors". The "General" tab is selected. Inside the window, there is an "Observation Window:" section with a text field showing "from 0.00 to 100.00 ms" and a "Configure..." button. Below this is a table with four columns: "CPU", "Total load", "Payload", and "System load". The table contains two rows of data: "CPU 1" and "Average".

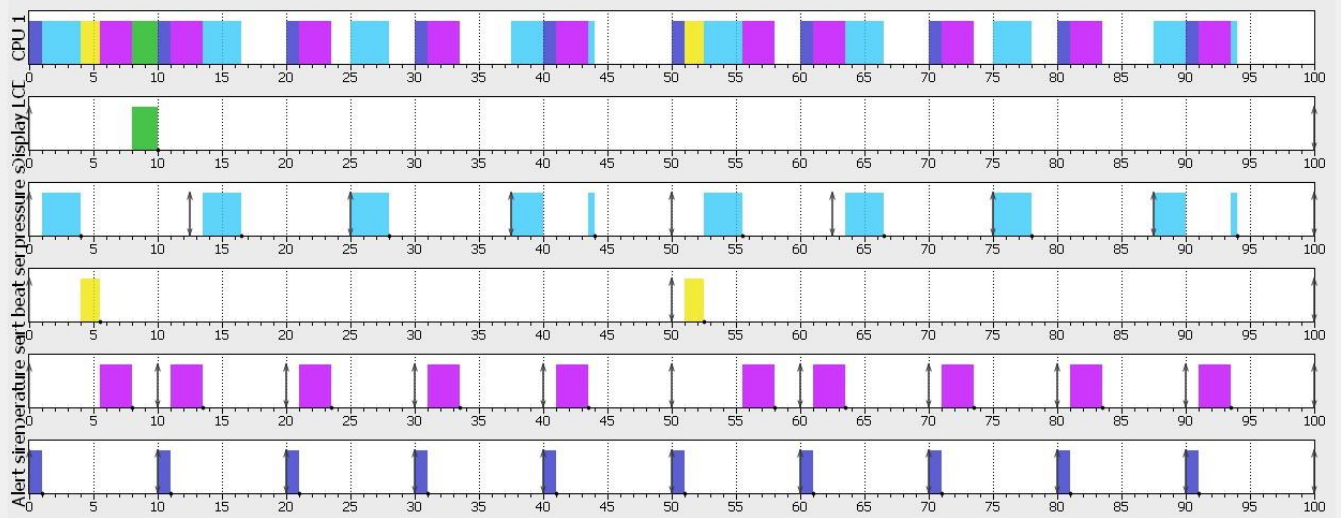
	Total load	Payload	System load
CPU 1	0.6400	0.6400	0.0000
Average	0.6400	0.6400	0.0000

6- Timeline manually

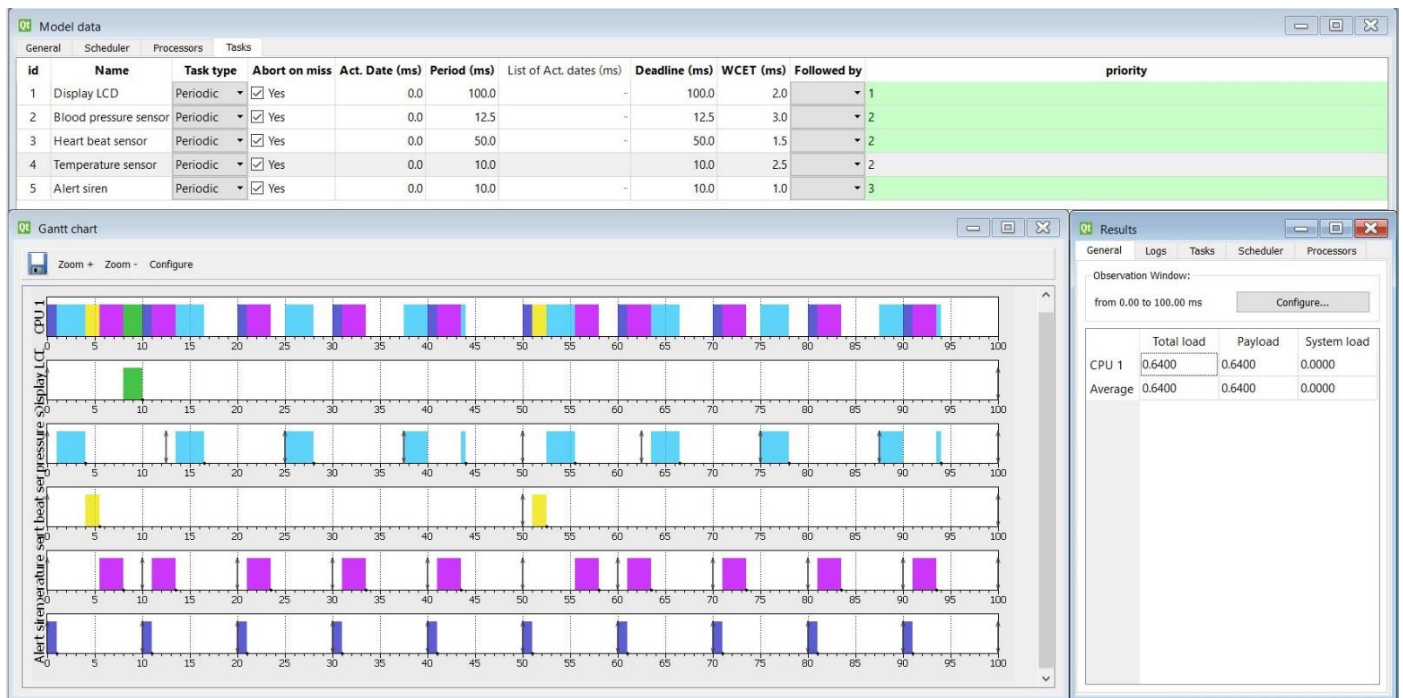


As we can observe from the manually drawn timeline, No task has missed its deadline and the system is schedulable.

Simso representation for timeline:



7- Simso test run:



Comparing Simso readings to the manual calculations, We notice that they are equal and that the system is schedulable.