

Designing a real-time Health-care system

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System Requirement

- **Task:** Design a healthcare system using RTOS with the following 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 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)

System consists of the following tasks:

LCD: execution time 2ms

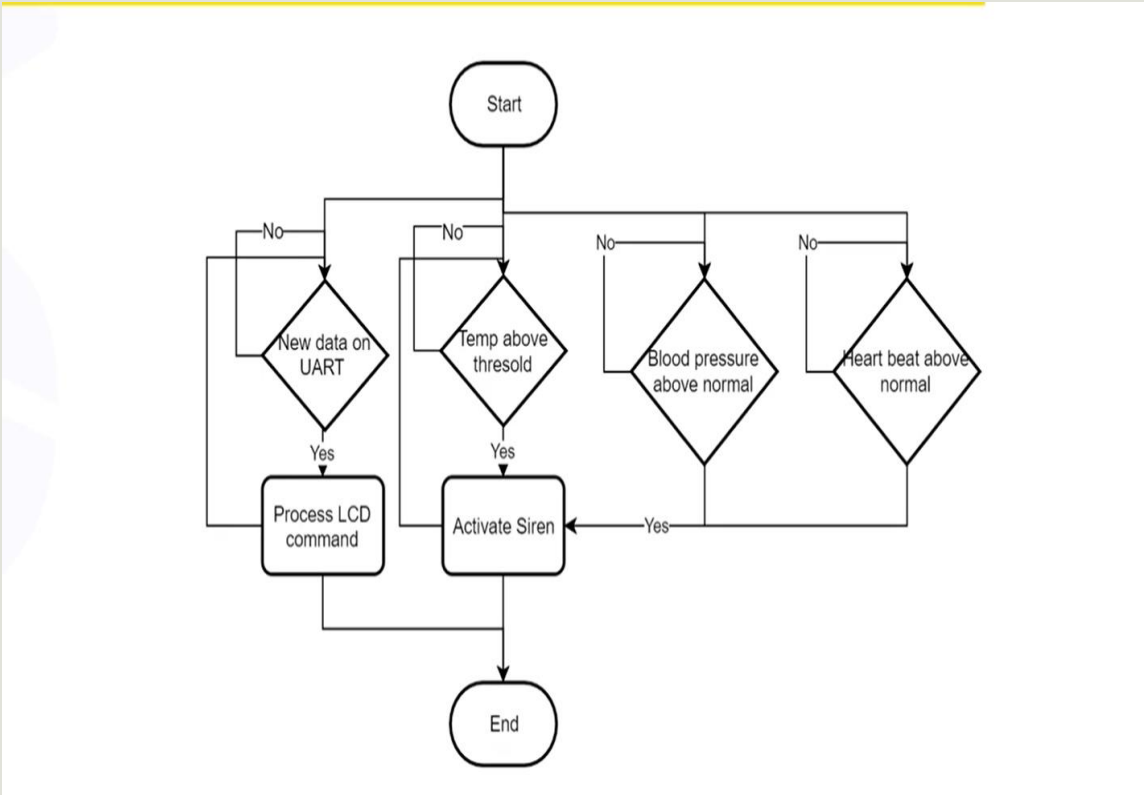
Blood pressure sensor: new data every 25ms-execution time 3ms

Heart-beat detector: new data every 100ms-execution time 1.5ms

Temperature sensor: new data every 10ms-execution time 2.5ms

Alert siren: execution time 1ms

S33system flow chart



Number of tasks needed:

5-Tasks are needed as following:

Task 1: Blood pressure sensor- Reading

Task 2: Heart-beat detector - Reading

Task 3: Temperature sensor - Reading

Task 4: Sending LCD input to UART

Task 5: Alert siren

Tasks' parameters: (priority-periodicity-deadline):

T1:Blood pressure sensor

{Priority:2
,Periodicity:10ms
,Deadline:10ms }

T2:Heart-beat detector

{Priority:2
,Periodicity:50ms
,Deadline:50ms }

T3:Temperature sensor

{Priority:2
,Periodicity:5ms
,Deadline:5ms }

T4:LCD & UART

{Priority:3
,Periodicity:50ms
,Deadline :50ms }

T5:Alert siren

{Priority:1
,Periodicity:suspended on event
,Deadline:2ms }

miro

System tick rate:

Systick value = total execution time of all tasks.

According to the following information:

LCD and UART: execution time 2ms

Blood pressure sensor: execution time 3ms

Heart-beat detector: execution time 1.5ms

Temperature sensor: execution time 2.5ms

Alert siren: execution time 1ms

Then:

System tick rate= 3ms + 1.5ms+ 2.5ms+ 2ms+ 1ms= **10ms**

Calculations: (Hyper period-CPU load):

(1)- Hyperperiod:

Hyperperiod (H) = LCM(Pi)

Hyperperiod= **100ms.**

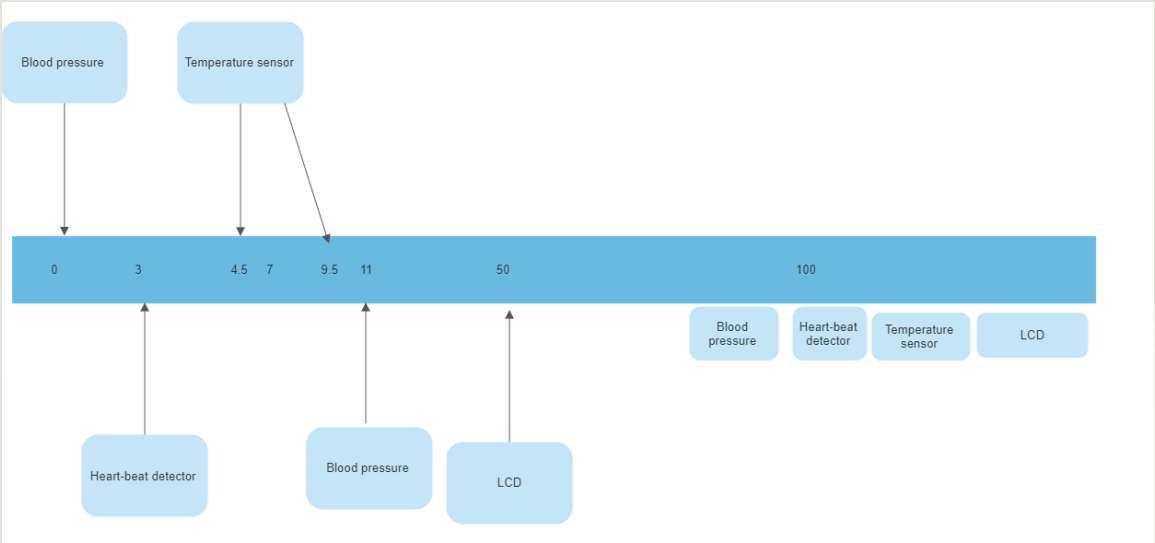
(2) CPU load:

CPU load (U) = E/H

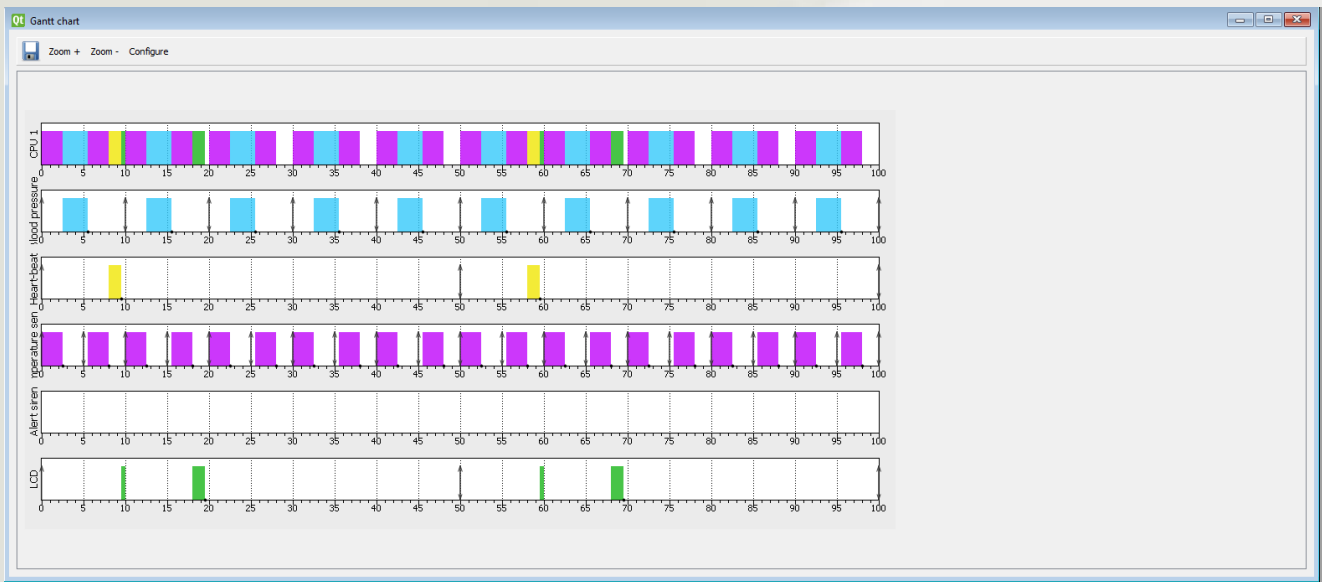
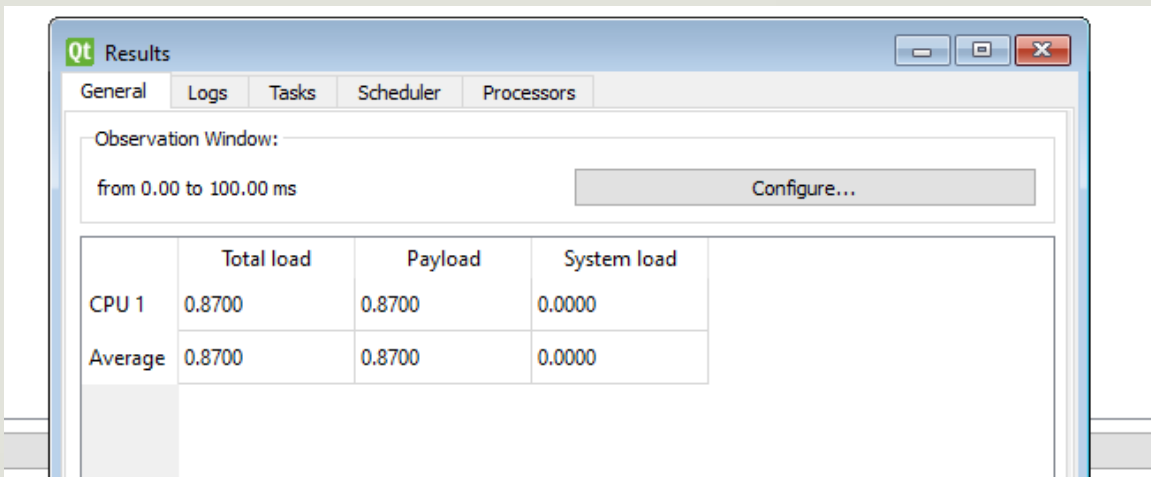
$E = (E1+E2+E3+E4+E5+E6) = (3*10 + 1.5*2 + 2.5*20 + 2*2) = 87$

$U = 87/100 = 0.87\%$

Timeline manually :



Simso Model :



Comments on the results and analysis:

- * The simulation verifies the same output as the analytical calculations CPU load=87%
- * it's already obvious that the system is heavily loaded!
- * You can track this load through the gantt chart where all the tasks have missed their deadlines.
- * The Alert siren task is suspended upon event (as getting threshold value reading from the sensors)