(RTOS) Project Design Document

1. Introduction:

This document outlines the design of the Real-Time Operating System (RTOS) project, which aims to control the seat heating system in a vehicle using an embedded system. The system employs FreeRTOS, a popular real-time operating system kernel for embedded devices.

2. System Overview:

The system consists of multiple concurrent tasks managing user interaction, temperature measurement, heater control, diagnostics, runtime tracking, and display functionalities. These tasks communicate using FreeRTOS queues, semaphores, and event groups to achieve real-time responsiveness and reliability.

3. Task Descriptions:

- **vButtonHandlerTask:**

Description: Monitors button presses for both driver and passenger to adjust heating levels.

Periodicity: Event-driven (on button press)

- **vProcessingTask:**

Description: Processes input events to adjust internal system states such as heating level and temperature-based control.

Periodicity: Triggered by queue events

- **vTempretureMeasurementTask:**

Description: Reads potentiometer value and calculates seat temperature according

Periodicity: Every 1000 ms.

- **vdisplayTask:**

Description: Displays current system state including temperature, heating levels, and heater states on UART.

Periodicity: Every 3000 ms

- **vDiagnosticsTask:**

Description: Records diagnostics info if temperature is out of range. (Currently commented out)

Periodicity: Triggered by semaphore

- **vRuntimeMeasurementTask:**

Description: Calculates execution time and CPU load of tasks. (Currently commented out)

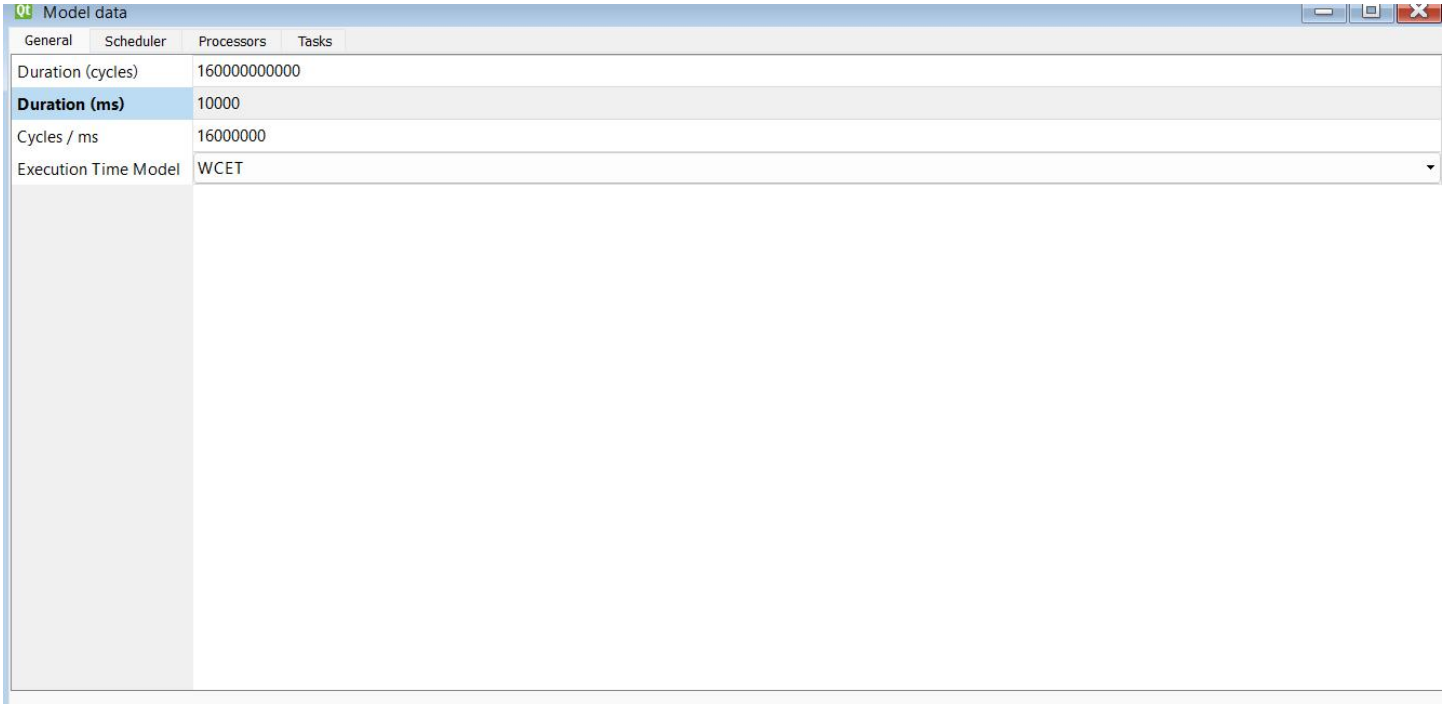
Periodicity: Every 3000 ms

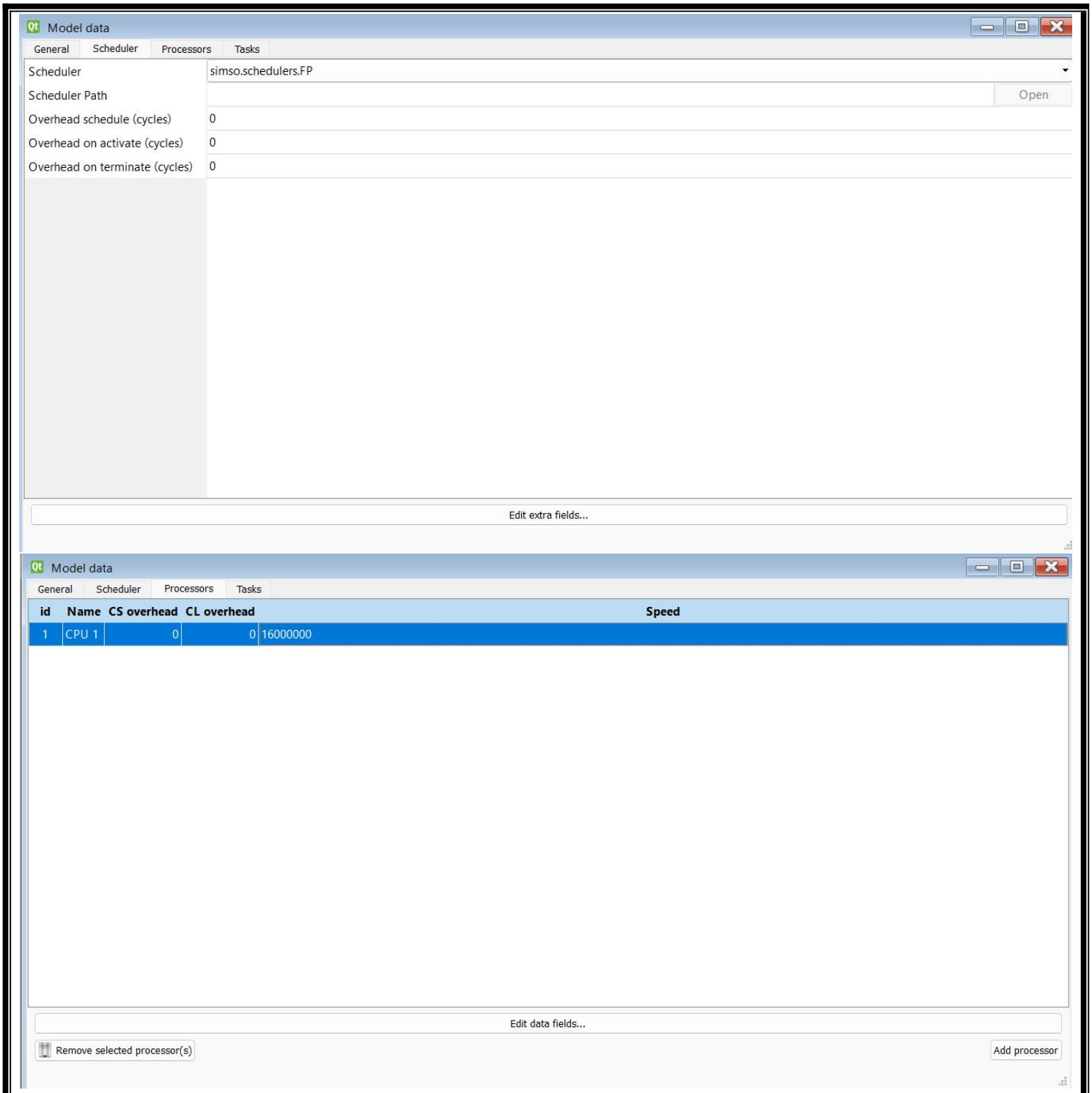
4. UART Messages:

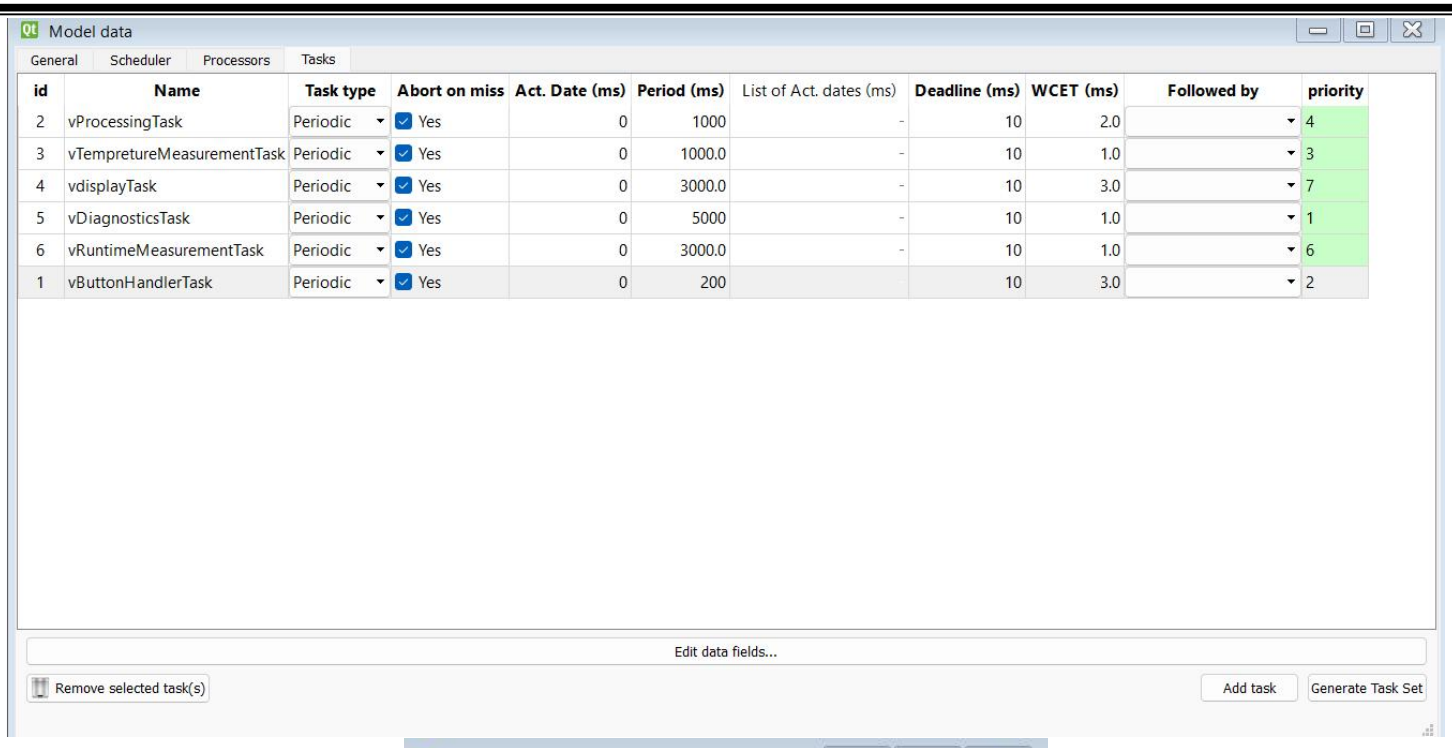
```
CAR TEMPREATURE  : 30
---------------------------------------------
DRIVER SEAT :
HEATING LEVEL -->  MEDIUM
HEATER STATE -->  LOW INTENSITY
PASSENGER SEAT -->
HEATING LEVEL -->  LOW
HEATER STATE -->  MEDIUM INTENSITY
=============================================
Runtime measurment :
vButtonHandlerTask : 3ms            |          vdisplayTask : 3ms
vProcessingTask : 2ms               |  vTempretureMeasurementTask : 1ms
vDiagnosticsTask : 0ms              |  vRuntimeMeasurementTask : 0ms
CPU LOAD ----------->  35%
```

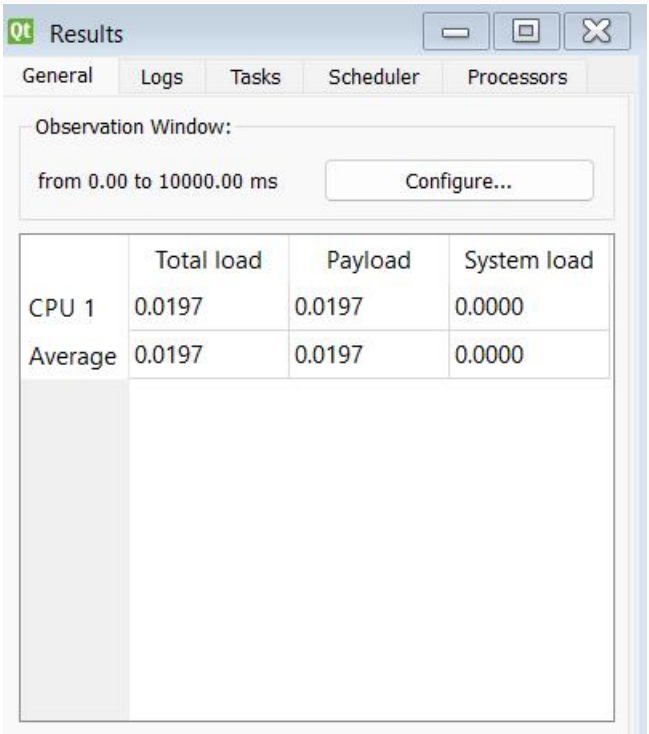
```
CAR TEMPREATURE  : 30
-----------------------------------------------
DRIVER SEAT :
HEATING LEVEL -->  OFF
HEATER STATE -->  DISABLED
PASSENGER SEAT -->
HEATING LEVEL -->  OFF
HEATER STATE -->  DISABLED
===============================================
Runtime measurment :
vButtonHandlerTask : 0ms             |          vdisplayTask : 3ms
vProcessingTask : 2ms                |  vTempretureMeasurementTask : 1ms
vDiagnosticsTask : 0ms               |  vRuntimeMeasurementTask : 0ms
CPU LOAD ----------->  20%
===============================================
```

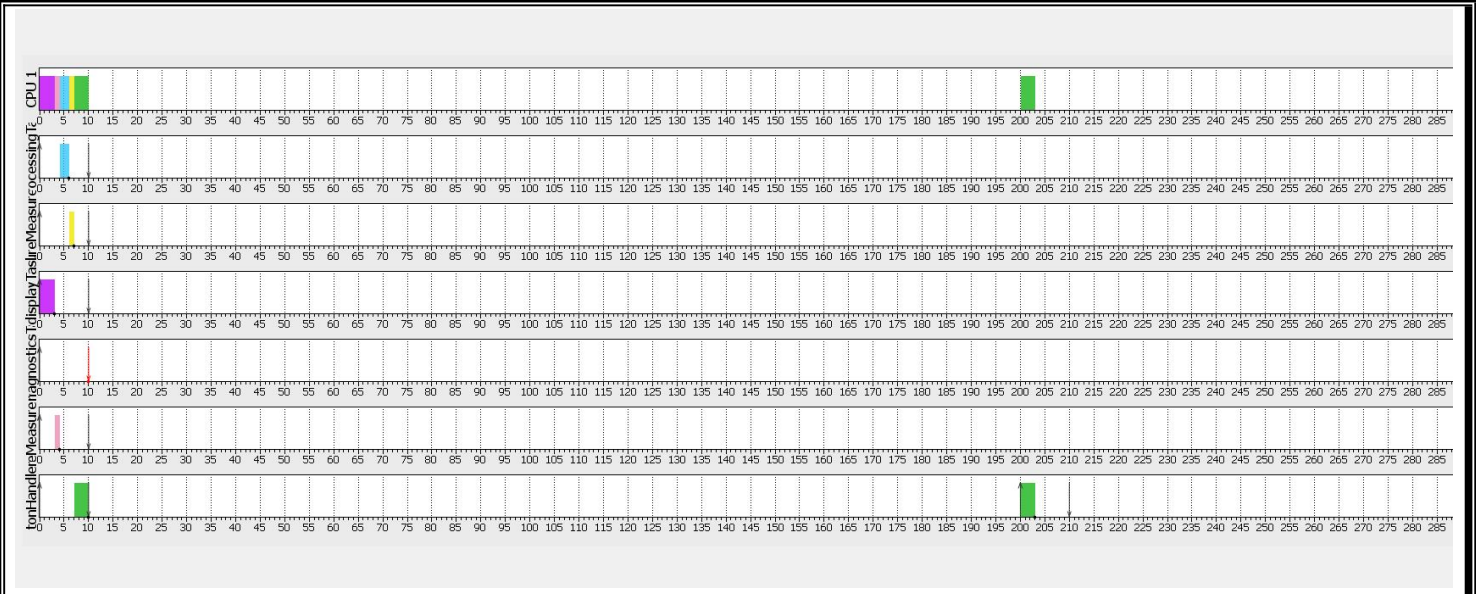
5. Simso Simulation:




Model data
General
Scheduler
Processors
Tasks
Scheduler
simso.schedulers.FP
Scheduler Path
Open
Overhead schedule (cycles)
0
Overhead on activate (cycles)
0
Overhead on terminate (cycles)
0
Edit extra fields...
Model data
General
Scheduler
Processors
Tasks
id
Name
CS overhead
CL overhead
Speed
1
CPU 1
0
0
16000000
Edit data fields...
Remove selected processor(s)
Add processor


Model data
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
2 vProcessingTask Periodic Yes 0 1000 - 10 2.0 4
3 vTempretureMeasurementTask Periodic Yes 0 1000.0 - 10 1.0 3
4 vdisplayTask Periodic Yes 0 3000.0 - 10 3.0 7
5 vDiagnosticsTask Periodic Yes 0 5000 - 10 1.0 1
6 vRuntimeMeasurementTask Periodic Yes 0 3000.0 - 10 1.0 6
1 vButtonHandlerTask Periodic Yes 0 200 10 3.0 2
Edit data fields...
Remove selected task(s)
Add task
Generate Task Set


Results
General
Logs
Tasks
Scheduler
Processors
Observation Window:
from 0.00 to 10000.00 ms
Configure...
Total load
Payload
System load
CPU 1 0.0197 0.0197 0.0000
Average 0.0197 0.0197 0.0000



6. Connections: