

Real-Time Operating System (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 several tasks designed to manage various aspects of the seat heating control system. These tasks include:

- CPU Load Measurement Task
- Tasks Time Measurement Task
- Display System State Task
- Seat 1 Adjust Heater Task
- Seat 2 Adjust Heater Task
- Get Seat 1 Current Temperature Task
- Get Seat 2 Current Temperature Task
- Check Seat 1 Heating Level Change Task
- Check Seat 2 Heating Level Change Task

These tasks operate concurrently and communicate with each other as necessary to ensure proper functioning of the system.

3. Task Descriptions

3.1 CPU Load Measurement Task

- **Description:** Measures the CPU load of the system.
- **Periodicity:** Executes every 1000 milliseconds.

3.2 Tasks Time Measurement Task

- **Description:** Measures the execution time of various tasks in the system.
- **Periodicity:** Executes every 1000 milliseconds.

3.3 Display System State Task

- **Description:** Displays the current state of the seat heating system, including temperature, heating levels, and heater intensity.
- **Periodicity:** Executes every 1000 milliseconds.

3.4 Seat 1 Adjust Heater Task

- **Description:** Adjusts the heater intensity for seat 1 based on the desired temperature and current temperature.
- **Periodicity:** Executes every 100 milliseconds.

3.5 Seat 2 Adjust Heater Task

- **Description:** Adjusts the heater intensity for seat 2 based on the desired temperature and current temperature.
- **Periodicity:** Executes every 100 milliseconds.

3.6 Get Seat 1 Current Temperature Task

- **Description:** Reads the current temperature of seat 1 using a sensor.
- **Periodicity:** Executes every 100 milliseconds.

3.7 Get Seat 2 Current Temperature Task

- **Description:** Reads the current temperature of seat 2 using a sensor.
- **Periodicity:** Executes every 100 milliseconds.

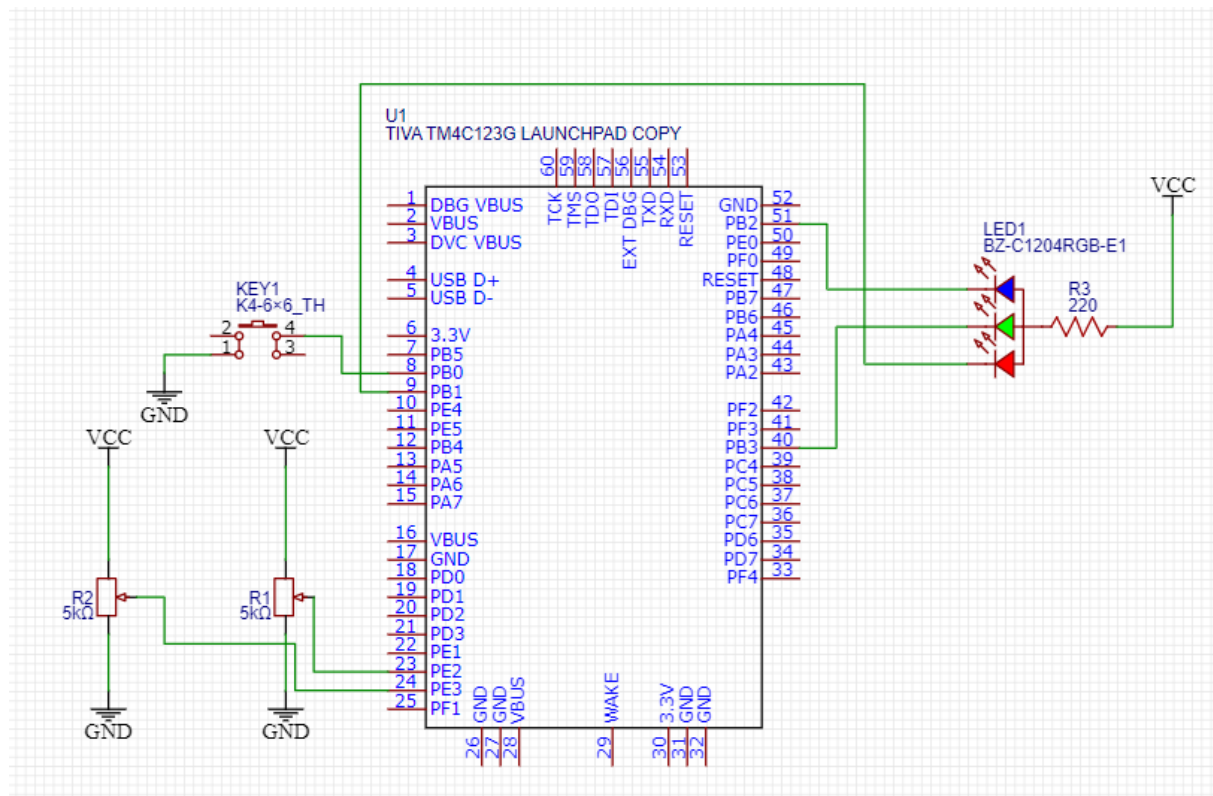
3.8 Check Seat 1 Heating Level Change Task

- **Description:** Monitors for user input to change the heating level for seat 1.
- **Periodicity:** Executes every 100 milliseconds.

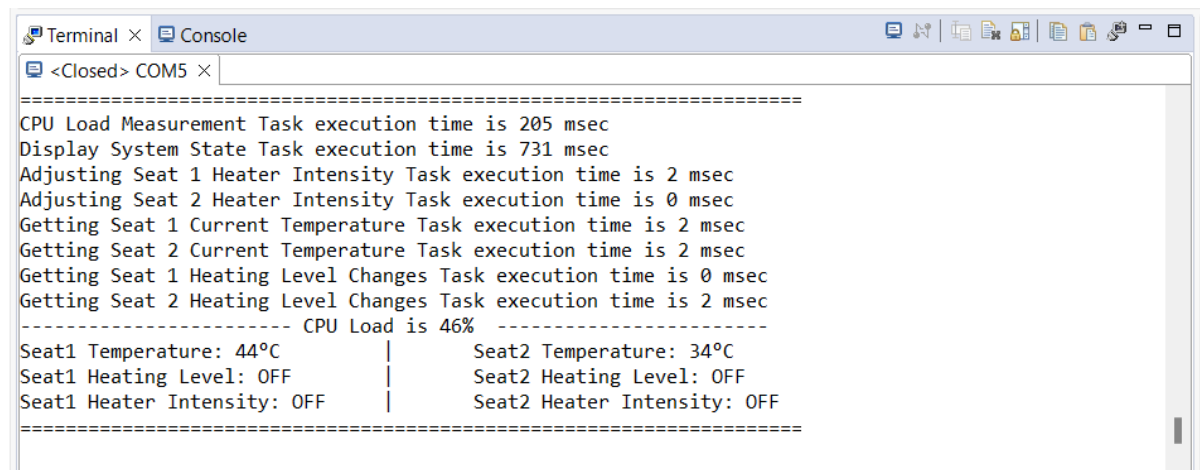
3.9 Check Seat 2 Heating Level Change Task

- **Description:** Monitors for user input to change the heating level for seat 2.
- **Periodicity:** Executes every 100 milliseconds.

4. Schematic Diagram



5. UART messages

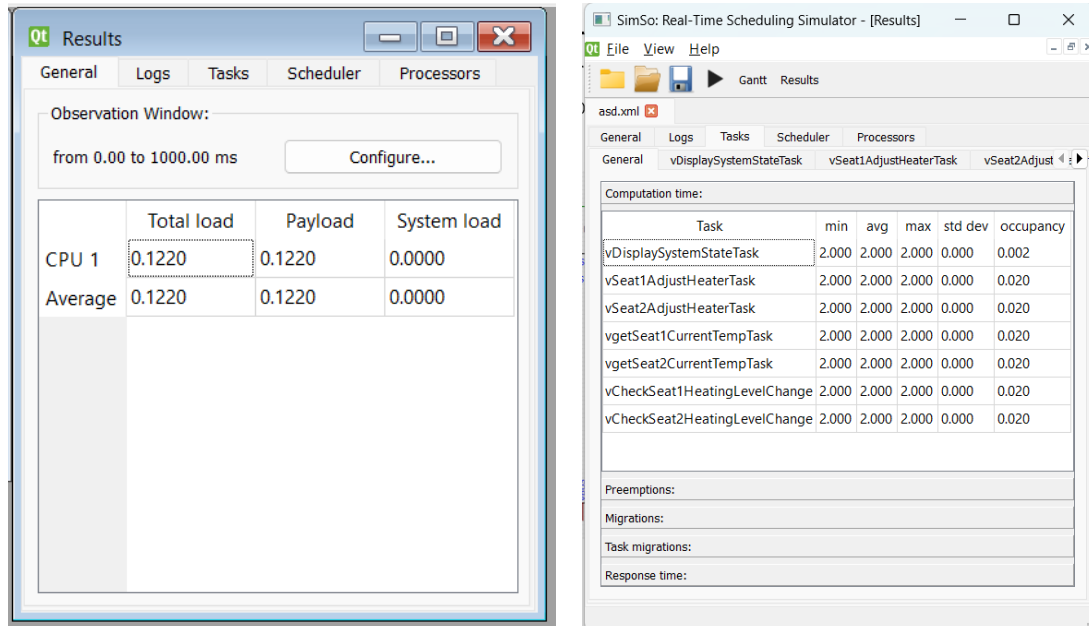


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CPU Load Measurement Task execution time is 205 msec
Display System State Task execution time is 731 msec
Adjusting Seat 1 Heater Intensity Task execution time is 2 msec
Adjusting Seat 2 Heater Intensity Task execution time is 0 msec
Getting Seat 1 Current Temperature Task execution time is 2 msec
Getting Seat 2 Current Temperature Task execution time is 2 msec
Getting Seat 1 Heating Level Changes Task execution time is 0 msec
Getting Seat 2 Heating Level Changes Task execution time is 2 msec
----- CPU Load is 46% -----
Seat1 Temperature: 44°C      |      Seat2 Temperature: 34°C
Seat1 Heating Level: OFF    |      Seat2 Heating Level: OFF
Seat1 Heater Intensity: OFF |      Seat2 Heater Intensity: OFF
=====
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----- CPU Load is 32% -----
Seat1 Temperature: 12°C      |      Seat2 Temperature: 20°C
Seat1 Heating Level: LOW    |      Seat2 Heating Level: LOW
Seat1 Heater Intensity: HIGH |      Seat2 Heater Intensity: MEDIUM
=====
```

6. Simso Simulation



Qt Results

General Logs Tasks Scheduler Processors

Observation Window:
from 0.00 to 1000.00 ms Configure...

	Total load	Payload	System load
CPU 1	0.1220	0.1220	0.0000
Average	0.1220	0.1220	0.0000

SimSo: Real-Time Scheduling Simulator - [Results]

File View Help

asd.xml

General Logs Tasks Scheduler Processors

General vDisplaySystemStateTask vSeat1AdjustHeaterTask vSeat2Adjust

Computation time:

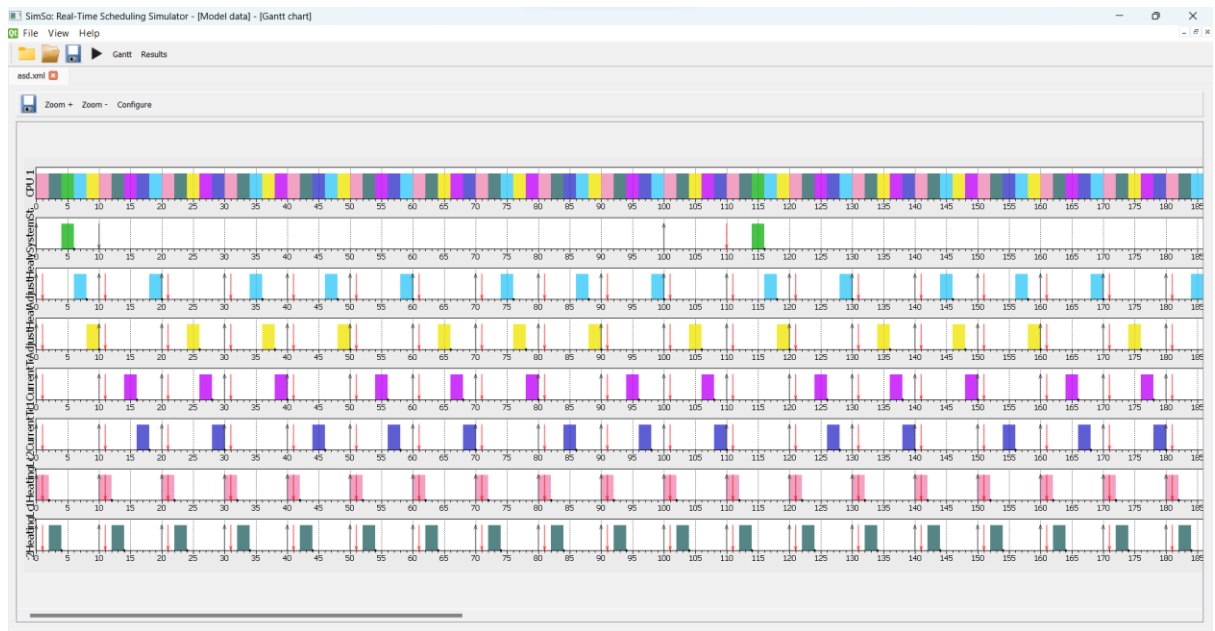
Task	min	avg	max	std dev	occupancy
vDisplaySystemStateTask	2.000	2.000	2.000	0.000	0.002
vSeat1AdjustHeaterTask	2.000	2.000	2.000	0.000	0.020
vSeat2AdjustHeaterTask	2.000	2.000	2.000	0.000	0.020
vgetSeat1CurrentTempTask	2.000	2.000	2.000	0.000	0.020
vgetSeat2CurrentTempTask	2.000	2.000	2.000	0.000	0.020
vCheckSeat1HeatingLevelChange	2.000	2.000	2.000	0.000	0.020
vCheckSeat2HeatingLevelChange	2.000	2.000	2.000	0.000	0.020

Preemptions:

Migrations:

Task migrations:

Response time:



7. Connections

