



Real-Time OS Project

Seat Heat Control

By: Mariam Hany Nabil Bestawrous



Introduction

This document outlines the design of a Real-Time Operating System (RTOS) project aimed at controlling a vehicle's seat heating system using embedded systems. The project utilises FreeRTOS as the operating system and Tiva-C microcontroller as the target platform. It demonstrates the application of real-time operating systems in embedded environments, focusing on efficient task scheduling, resource management, and system reliability.



System Overview

The system Consists of Several Tasks designed to perform the whole functionality :

1. Button Press Management Task : This fn is an event based function where it's called when the user(driver/passenger) presses the button for temperature adjustment.This function has 2 instances one for the driver and another for the passenger seats .
2. Temperature Monitor Task: A periodic function that is run every 300 ms to read the current temperature of both seats using ADC.This function has just one instance for both seats .
3. Heat Control Task: This task is a periodic task that is run every 500 ms that is waiting for Button Press Management event to respond to the user's action to adjust the temperature to the desired level.Has 2 instances .

4. Display Update Task : A periodic task called ever 3 sec to display some data on the screen.Has just 1 instance.
5. CPULoad Measurement Task: A periodic task that is called every 2 sec for cpu load calc . Has just 1 instance
6. Failure Logging Task :A periodic function that is called every 1.5 sec for failure logging check and display if found .Has just 1 instance.

All these tasks operate concurrently and communicate with each other as necessary to ensure proper functionality and safe system running .

Shared Resources :

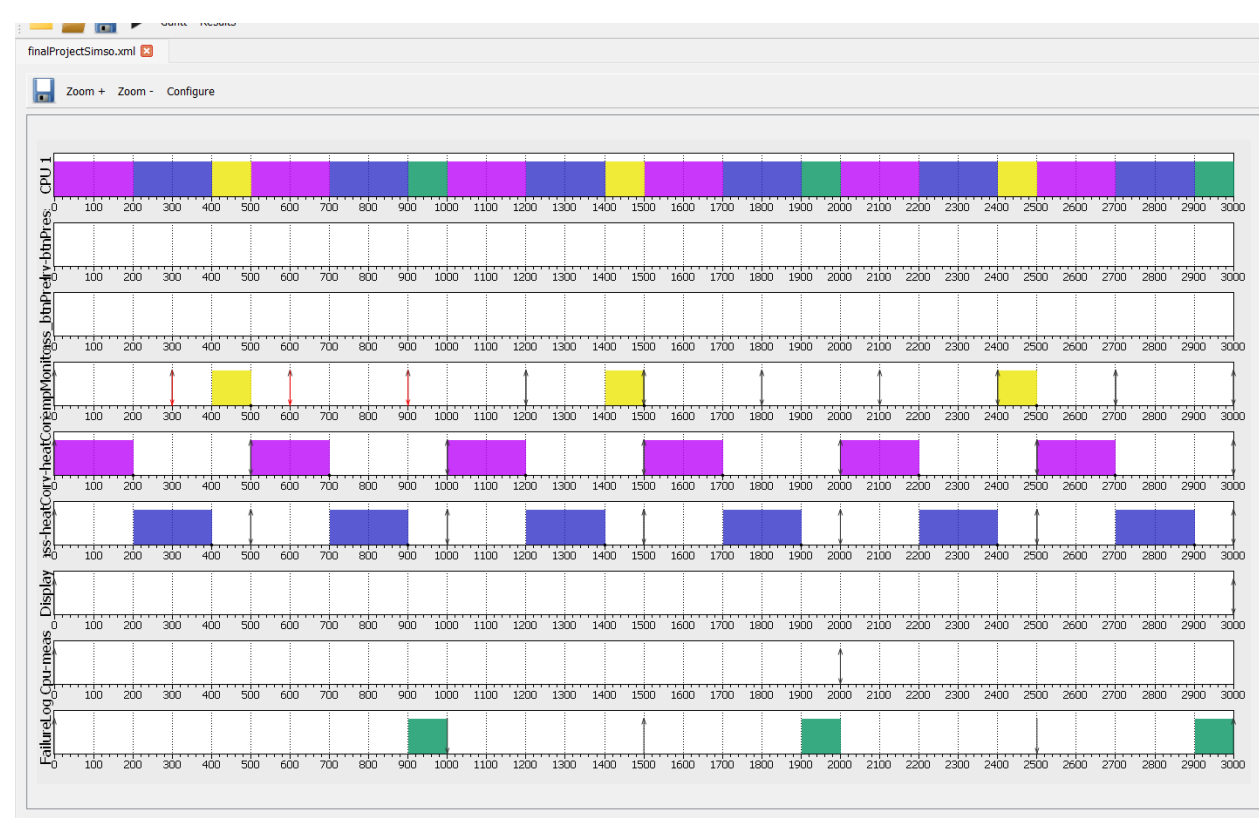
Just 1 shared resource which is the UART and handled using the mutex

UART Messages

```
Passenger:
Seat Desired Heat Level: SEAT_HEATING_OFF
Seat Heater Intensity: HEATER_OFF
Seat Current Temperature:32
////////////////////
CPU Load is 77%
Heating level changed
Heating level changed
Driver:
Seat Desired Heat Level: SEAT_HEATING_OFF
Seat Heater Intensity: HEATER_OFF
Seat Current Temperature:14
////////////////////
Passenger:
Seat Desired Heat Level: MED_SEAT_HEAT_TEMP
Seat Heater Intensity: HEATER_LOW
Seat Current Temperature:32
////////////////////
CPU Load is 75%
CPU Load is 70%
Driver:
Seat Desired Heat Level: SEAT_HEATING_OFF
Seat Heater Intensity: HEATER_OFF
Seat Current Temperature:14
////////////////////
Passenger:
Seat Desired Heat Level: HIGH_SEAT_HEAT_TEMP
Seat Heater Intensity: HEATER_LOW
Seat Current Temperature:32
////////////////////
Heating level changed
```

CPU Load is 77%

CPU Load is 75%



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
1	drv-btnPress	APeriodic	<input type="checkbox"/> No	-	-	-	10.0	0.5	4	
2	pass_btnPress	APeriodic	<input type="checkbox"/> No	-	-	-	10.0	0.5	4	
3	TempMonitor	Periodic	<input type="checkbox"/> No	0.0	300	-	300	100	2	
4	drv-heatCont	Periodic	<input type="checkbox"/> No	0.0	500	-	500	200	3	
5	pass-heatCont	Periodic	<input type="checkbox"/> No	0.0	500	-	500	200	3	
6	Display	Periodic	<input type="checkbox"/> No	0.0	3000	-	3000	500	1	
8	Cpu-meas	Periodic	<input type="checkbox"/> No	0.0	2000	-	2000	400	1	
9	FailureLog	Periodic	<input type="checkbox"/> No	0.0	1500	-	1000	500	2	



Real Circuit Connection:

