Seat Heater Control System

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Task 1: vTempSettingTask for Driver
- Task Description: This task sets the temperature for the driver based on the DriverState. It waits for an event bit to be set (specifically mainSW1_INTERRUPT_BIT) to trigger the temperature setting. It uses a mutex (DesiredTempMutexDriver) to safely access and update the DesiredTempDriver variable.
- Type: Event-based
- Events:
    - Waits for: mainSW1_INTERRUPT_BIT (event bit indicating that a temperature setting request for the driver has occurred)
    - Sets: No specific event bits are set by this task.

Task 2: vTempSettingTask for Passenger
- Task Description: This task sets the temperature for the passenger based on the PassengerState. It waits for an event bit to be set (specifically mainSW2_INTERRUPT_BIT) to trigger the temperature setting. It uses a mutex (DesiredTempMutexPassenger) to safely access and update the DesiredTempPassenger variable.
- Type: Event-based
- Events:
    - Waits for: mainSW2_INTERRUPT_BIT (event bit indicating that a temperature setting request for the passenger has occurred)
    - Sets: No specific event bits are set by this task.

Task 3: vTempReadingTask for Driver
- Task Description: This task reads the temperature value from an ADC channel and updates the current temperature for the driver. It also sends the temperature value to a queue for display purposes. The task operates based on a delay and handles synchronization with a mutex to avoid concurrent access issues.
- Type: Periodic
- Periodicity: Executes every 200 milliseconds.
- Events:
  - Waits for: No specific event bits or conditions to wait for.
  - Sets: No specific event bits are set by this task.

Task 4: vTempReadingTask for Passenger
- Task Description: This task reads the temperature value from an ADC channel and updates the current temperature for the passenger. It also sends the temperature value to a queue for display purposes. The task operates based on a delay and handles synchronization with a mutex to avoid concurrent access issues.
- Type: Periodic
- Periodicity: Executes every 200 milliseconds.
- Events:
  - Waits for: No specific event bits or conditions to wait for.
  - Sets: No specific event bits are set by this task.

Task 5: vHeaterControllerTask for Driver
- Task Description: This task controls the heating system for the driver seat based on the current temperature and the desired temperature. It reads the current temperature and desired temperature from shared resources, calculates the heat intensity needed, and sends this information to the heating controller and display.
- Type: Periodic
- Periodicity: Executes every 200 milliseconds.
- Events:
    - Waits for: No specific event bits or conditions to wait for.
    - Sets: No specific event bits are set by this task.

Task 6: vHeaterControllerTask for Passenger
- Task Description: This task controls the heating system for the passenger seat based on the current temperature and the desired temperature. It reads the current temperature and desired temperature from shared resources, calculates the heat intensity needed, and sends this information to the heating controller and display.
- Type: Periodic
- Periodicity: Executes every 200 milliseconds.
- Events:
    - Waits for: No specific event bits or conditions to wait for.
    - Sets: No specific event bits are set by this task.

Task 7: vHeaterLedsControllerTask for Driver
- Task Description: This task controls the LEDs for the driver's seat to indicate the current heating intensity level based on the received value. It updates the LEDs to reflect the heating status (ERROR, OFF, LOW, MEDIUM, HIGH).
- Type: Event-based
- Events:
  - Waits for: Receives heating intensity values from the Controller_HeatingDriver queue.
  - Sets: No specific event bits are set by this task.

Task 8: vHeaterLedsControllerTask for Passenger
- Task Description: This task controls the LEDs for the passenger's seat to indicate the current heating intensity level based on the received value. It updates the LEDs to reflect the heating status (ERROR, OFF, LOW, MEDIUM, HIGH).
- Type: Event-based
- Events:
  - Waits for: Receives heating intensity values from the Controller_HeatingPassenger queue.
  - Sets: No specific event bits are set by this task.

Task 9: vDisplayTask for Driver
- Task Description: This task retrieves and displays information related to the driver's seat, including current temperature, heat level, and heat state. The information is sent to the display using UART.
- Type: Event-based
- Events:
  - Waits for:
    - Temperature data from the Reading_DisplayDriver queue.
    - Heat state data from the Controller_DisplayDriver queue.
  - Sets: No specific event bits are set by this task.

Task 10: vDisplayTask for Passenger
- Task Description: This task retrieves and displays information related to the passenger's seat, including current temperature, heat level, and heat state. The information is sent to the display using UART.
- Type: Event-based
- Events:
  - Waits for:
    - Temperature data from the Reading_DisplayPassenger queue.
    - Heat state data from the Controller_DisplayPassenger queue.
  - Sets: No specific event bits are set by this task.

Task 11: vRunTimeMeasurementsTask
- Task Description: Measures and reports the CPU load percentage. It aggregates the execution times of tasks and calculates the CPU load based on these measurements. The CPU load is then sent to a display via UART.
- Type: Periodic.
- Events:
  - Waits for: No specific event bits or conditions to wait for
  - Sets: No specific event bits are set by this task.

Shared Resources Details

- CurrentTempMutexDriver:
  - Shared by: vTempReadingTask (Driver) and vHeaterControllerTask (Driver)
  - Method: xSemaphoreTake and xSemaphoreGive to ensure exclusive access.
- CurrentTempMutexPassenger
  - Shared by: vTempReadingTask (Passenger) and vHeaterControllerTask (Passenger)
  - Method: xSemaphoreTake and xSemaphoreGive to ensure exclusive access.
- DesiredTempMutexDriver
  - Shared by: vTempSettingTask (Driver) and vHeaterControllerTask (Driver)
  - Method: xSemaphoreTake and xSemaphoreGive to ensure exclusive access.
- DesiredTempMutexPassenger
  - Shared by: vTempSettingTask (Passenger) and vHeaterControllerTask (Passenger)
  - Method: xSemaphoreTake and xSemaphoreGive to ensure exclusive access.
- UARTMutex
  - Shared by: vDisplayTask (Driver), vDisplayTask (Passenger), and vRunTimeMeasurementsTask
  - Method: xSemaphoreTake and xSemaphoreGive to ensure exclusive access.
- Reading_DisplayDriver Queue
  - Shared by: vTempReadingTask (Driver) and vDisplayTask (Driver)
  - Method: xQueueSend and xQueueReceive to pass data between tasks.

Shared Resources Details

- Reading_DisplayPassenger Queue
  - Shared by: vTempReadingTask (Passenger) and vDisplayTask (Passenger)
  - Method: xQueueSend and xQueueReceive to pass data between tasks.
- Controller_HeatingDriver Queue
  - Shared by: vHeaterControllerTask (Driver) and vHeaterLedsControllerTask (Driver)
  - Method: xQueueSend and xQueueReceive to pass data between tasks.
- Controller_HeatingPassenger Queue
  - Shared by: vHeaterControllerTask (Passenger) and vHeaterLedsControllerTask (Passenger)
  - Method: xQueueSend and xQueueReceive to pass data between tasks.
- Controller_DisplayDriver Queue
  - Shared by: vHeaterControllerTask (Driver) and vDisplayTask (Driver)
  - Method: xQueueSend and xQueueReceive to pass data between tasks.
- Controller_DisplayPassenger Queue
  - Shared by: vHeaterControllerTask (Passenger) and vDisplayTask (Passenger)
  - Method: xQueueSend and xQueueReceive to pass data between tasks.
- eventTempSet Event Group
  - Shared by: GPIOPortF_Handler, GPIOPortB_Handler, and vTempSettingTask
  - Method: xEventGroupSetBitsFromISR and xEventGroupWaitBits to synchronize tasks with events.

Screenshots

```
Driver:
Current Temperature = 8 Degree
Required Heating Level = 20 Degree
The Heater is Working with HIGH Intensity

Passenger:
Current Temperature = 23 Degree
Required Heating Level = 0 Degree
The Heater is Working with NO Intensity

Driver:
Current Temperature = 8 Degree
Required Heating Level = 0 Degree
The Heater is Working with NO Intensity

Passenger:
Current Temperature = 26 Degree
Required Heating Level = 30 Degree
The Heater is Working with LOW Intensity
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Runtime Simulation Results

	Total load	Payload	System load
CPU 1	0.7340	0.7340	0.0000
Average	0.7340	0.7340	0.0000

Simso Measurement Results

Task	min	avg	max	std dev	occupancy
SetTempForDriver	30.000	30.000	30.000	0.000	0.060
SetTempForPassenger	30.000	30.000	30.000	0.000	0.060
ReadTempForDriver	17.000	17.000	17.000	0.000	0.085
ReadTempForPassenger	17.000	17.000	17.000	0.000	0.085
ControlTempForDriver	13.000	13.000	13.000	0.000	0.065
ControlTempForPassenger	13.000	13.000	13.000	0.000	0.065
ControlLedsForDriver	17.000	17.000	17.000	0.000	0.085
ControlLedsForPassenger	17.000	17.000	17.000	0.000	0.085
DisplayForDriver	13.000	13.000	13.000	0.000	0.065
DisplayForPassenger	13.000	13.000	13.000	0.000	0.065
RunTimeMeasurements	7.000	7.000	7.000	0.000	0.014