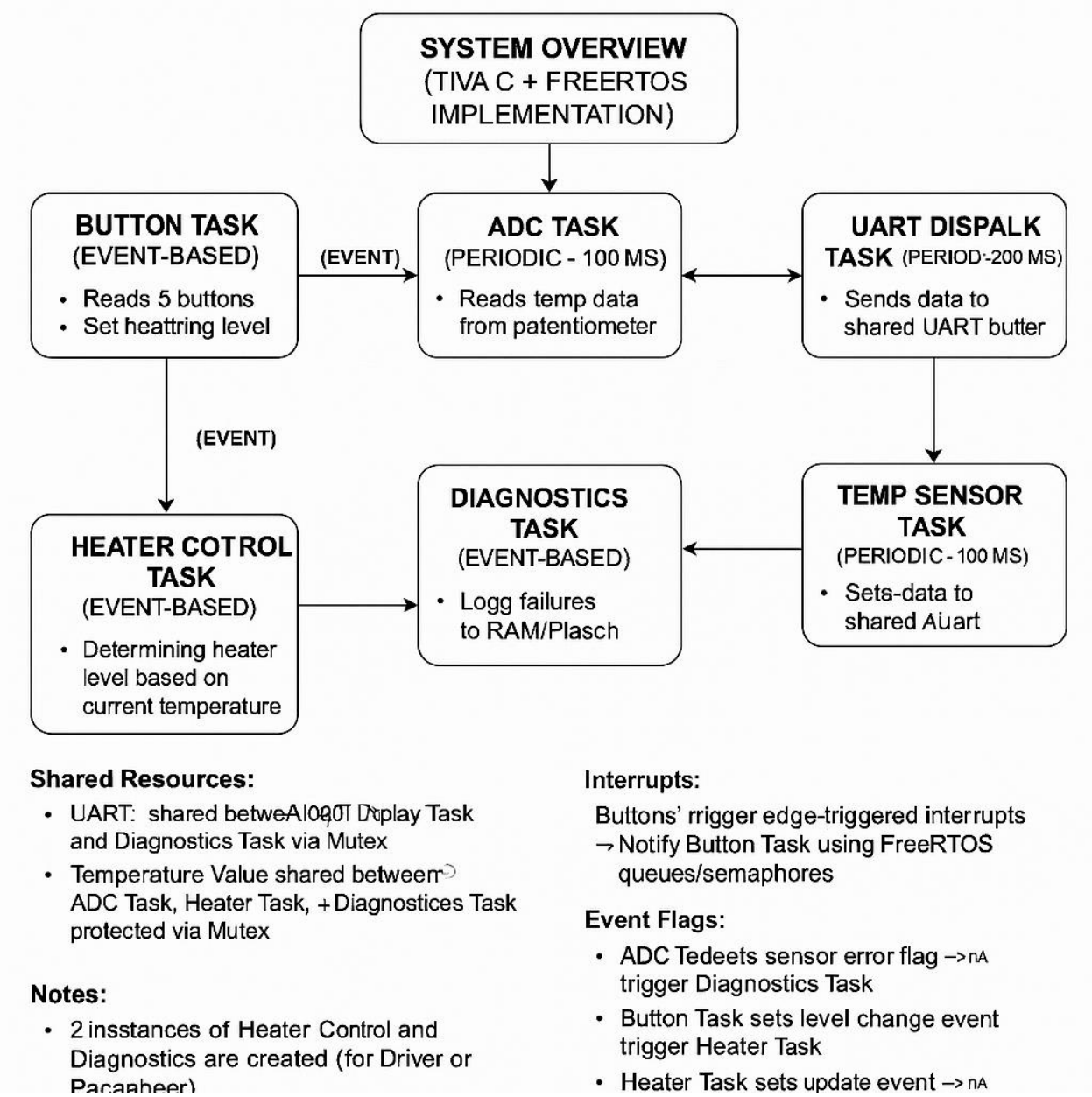
Diagram for the system design containing all task details



a)Description:

1. Button Handle Task: This Task is responsible for handling the number of button-presses and setting the required heating level corresponding to it and save it in a global variable, it handles all presses by 2 buttons of the driver and 1 of the passenger

2. Init Conversion Task: This Task is responsible for setting the bit responsible for ADC initiating conversion. When the ADC finishes this. conversion it triggers and interrupt where the ADC handler reads the temperature and save it in a global variable and sets the Error Semaphore if the temperature is out of range
3. Intensity Control Task: This Task is responsible for Identifying the needed heater intensity based on the current temperature and the required heating level and send the required intensity in a Queue to communicate with the Heater Control Task.
4. Heater Control Task :It receives the required intensity from the Queue and apply the needed intensity to the Heater actuator
5. Display Task : Description Display the current temperature, the heating level, and the heater state should be displayed on the screen by sending it through the UART.
6. Error Task :The Task is activated when error occurred to handle the corresponding error and sets the corresponding error flag to trigger the Diagnostic Task to save this error and suspend the intensity control task to stop controlling the temperature.
7. Diagnostic Task : Description Store the following in both the RAM in a Queue and in the non-volatile memory EEPRROM as well • The failure along with the timestamp (using GPTM) at which the failure occurred. • The last heating level set by the user (off, low, medium, or high) with its timestamp

b) Type:

1-Button Handle Task: Button Press Event-Based which is set by the GPIO ISR.

Events: The Task waits for 2 events which one of them indicates the driver increment number of presses event and the other is the

passenger's. Those 2 Events are set by the GPIO ISR based on the pressed button

2-Init Conversion Task: Periodic

c) Periodicity :500 ms.

3-Intensity Control Task: Periodic.

c) Periodicity :200 ms

4-Heater Control Task : Periodic.

c) Periodicity: 200 ms

5-Display Task : Periodic

c) Periodicity: 1000 ms

6-Error Task : Event Based

c) Events: The Task waits until the Error Semaphore is given to indicate that error occurred. It sets an event corresponding to the error occurred to trigger the Diagnostic task.

7-Diagnostic Task : Periodic and Event Based.

d) Events: It waits for error event to occur to indicate failure and save this failure in the RAM and non-volatile memory EEPROM

c. Shared Resources

Driver Seat

Resource	**Type**	**Accessed By**	**Access Method**
`Driver Seat Required Temperature`	Global Variable	Button Handle Task, Driver Intensity Control Task	**Mutex**

Driver Seat Current Temperature	Global Variable	ADC0 Handler ISR, Driver Intensity Control Task	**Semaphore** (from ISR)

Passenger Seat

Resource	**Type**	**Accessed By**	**Access Method**
Passenger Seat Required Temperature	Global Variable	Button Handle Task, Passenger Intensity Control Task	Mutex
Passenger Seat Current Temperature	Global Variable	ADC1 Handler ISR, Passenger Intensity Control Task	**Semaphore** (from ISR)

Run time measurement results:

1. CPU Load :34%
2. Tasks Execution Time:

- Temperature Initiate Conversion Task: 0.1

-Intensity Control Task :0.1

-Button Handle Task :0.1

-Heater Control Task :0.1

-Diagnostic Task :0.6

-Error Handle 0.1

-Display Task :334.3

3. Resource lock time per task:

Driver Seat

Resource	**Type**	Lock Time	**Accessed By**	Lock Time

Driver Seat Required Temperature	Global Variable	0.1	Button Handle Task, Driver Intensity Control Task	0.3
Driver Seat Current Temperature	Global Variable	0.1	ADC0 Handler ISR, Driver Intensity Control Task	0.2

Passenger Seat

Resource	**Type**	Lock Time	**Accessed By**	Lock Time
Passenger Seat Required Temperature	Global Variable	0.1	Button Handle Task, Passenger Intensity Control Task	0.3
Passenger Seat Current Temperature	Global Variable	0.1	ADC1 Handler ISR, Passenger Intensity Control Task	0.2

SimSo Simulation Results:

Task	min	avg	max	std dev	occupancy
Driver Intensity Control Task	1.000	1.000	1.000	0.000	0.005
Passenger Intensity Control Task	1.000	1.000	1.000	0.000	0.005
Driver Heater Task	1.000	1.000	1.000	0.000	0.005
Passenger Heater Task	1.000	1.000	1.000	0.000	0.005
Driver Temp Read Task	1.000	1.000	1.000	0.000	0.002
Passenger Temp Read Task	1.000	1.000	1.000	0.000	0.002
Display Task	334.000	334.000	334.000	0.000	0.334
Diagnostic Task	1.000	1.000	1.000	0.000	0.002
Button Task	1.000	1.000	1.000	0.000	0.002
Driver Handle Error Task	1.000	1.000	1.000	0.000	0.001
Passenger Handle Error Task	1.000	1.000	1.000	0.000	0.001

	Total load	Payload	System load
CPU 1	0.3640	0.3640	0.0000
Average	0.3640	0.3640	0.0000