

Firmware Architecture Description

The Project involves two boards – BeagleBone Green & TIVA TM4C. BeagleBone Green is used as a remote logger system while TIVA board which has FreeRTOS running on it is used as a sensor hub.

The sensor hub uses 2 sensors Humidity Sensor(BME 280(cheapest we could find))) and Ultrasonic Sensor(HC-SR04). The ultrasonic sensor is used to detect unauthorized intrusion through the door and send the user an alert through logging it and Humidity Sensor is used to determine if the Humidifier should be turned on.

The Remote Loggers used to take logging information from the sensor hub and log it. A message API is also implemented on the BeagleBone Green to send command such as modify humidity threshold for switching on the humidifier and to modify the door width.

TIVA TM4C (FreeRTOS)

Humidity Task

Humidity task is used to interact with the humidity sensor(BME 280). It constantly logs the humidity and also suggests the user to switch on the humidifier if the humidity falls below the threshold.

- **read_humidity()** This function is used to read the humidity value.
- **set_humidity_threshold()** This function is used to set humidity threshold.
- **heartbeat_alive_respond()** This function is used to respond to the heartbeat request with an alive response.
- **setup_humidity_sensor()** This function is used to set up the humidity sensor.
- **shutdown_humidity_sensor()** This function is used to shutdown the humidity sensor.

Intruder Detection Task

Intruder Detection Task makes use of Ultrasonic sensor(HC-SR04). It sends the user an alert and send a log message when there is a case of intrusion.

- **read_humidity()** This function is used to read the humidity value.
- **set_distance_threshold()** This function is used to set distance of the other end of the door threshold.
- **heartbeat_alive_respond()** This function is used to respond to the heartbeat request with an alive response.
- **setup_ultrasonic_sensor()** This function is used to set up the humidity sensor.
- **shutdown_ultrasonic_sensor()** This function is used to shutdown the humidity sensor.

Remote Request Socket Task

This task accepts requests for humidity readings from humidity sensor through the socket on the Ethernet interface. This accepts such requests from an BeagleBone Green. The unix sockets keeps listening for connections from BeagleBone. Once a connection with an external process on BeagleBone has been made, it is ready to accept requests from the external process.

This task accepts requests for humidity readings from humidity sensor, change the humidity threshold and to change the door width i.e. changing the distance threshold for Ultrasonic sensor. This accepts such requests from an external process on BeagleBone Green.

BeagleBone Green(Embedded Linux)

Logger Task

This function is used to receive logs from various sensors on the TIVA board and this task should be responsible for writing all of the logs to a common log file whose location is given at the time of executing the program. The synchronization is achieved through a logger queue.

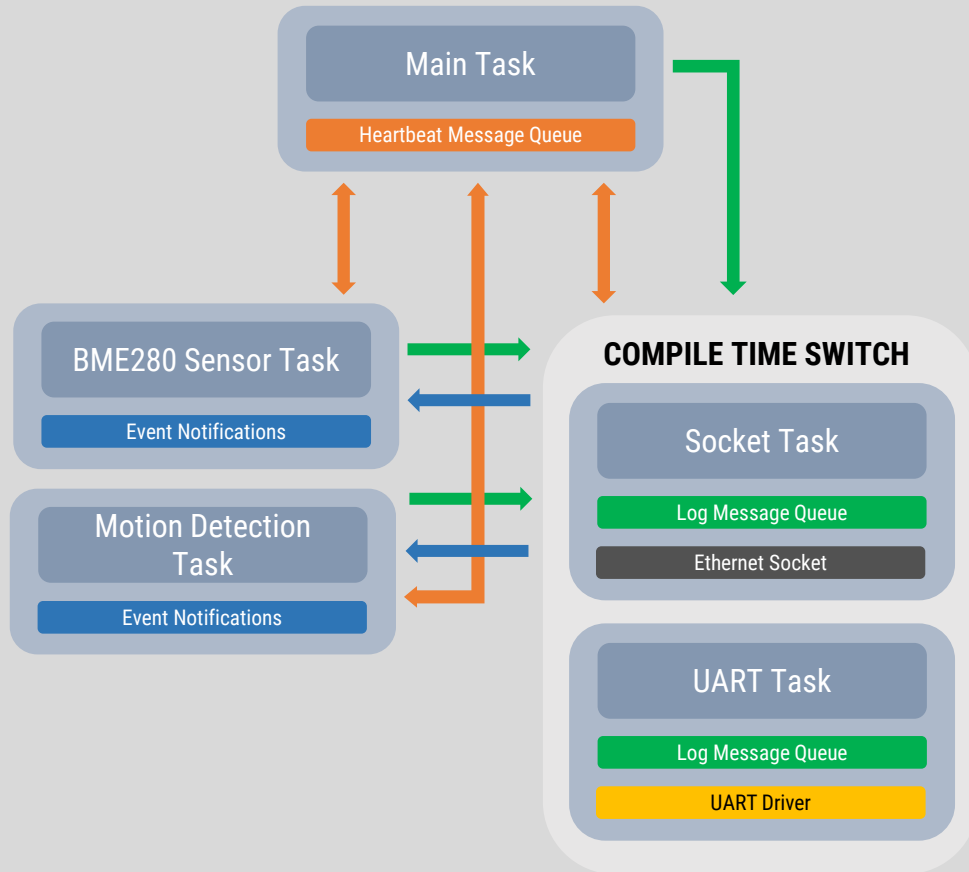
The driver task makes use of the following interfaces/functions:

- **check_logger_queue()** This function is used to check if the logger queue is empty. It returns true if the logger queue is empty.
- **write_logs()** This function is used to log the log information which is first in the logger queue.
- **heartbeat_alive_respond()** This function is used to respond to the heartbeat request from the main task with an alive response.

TIVA FreeRTOS

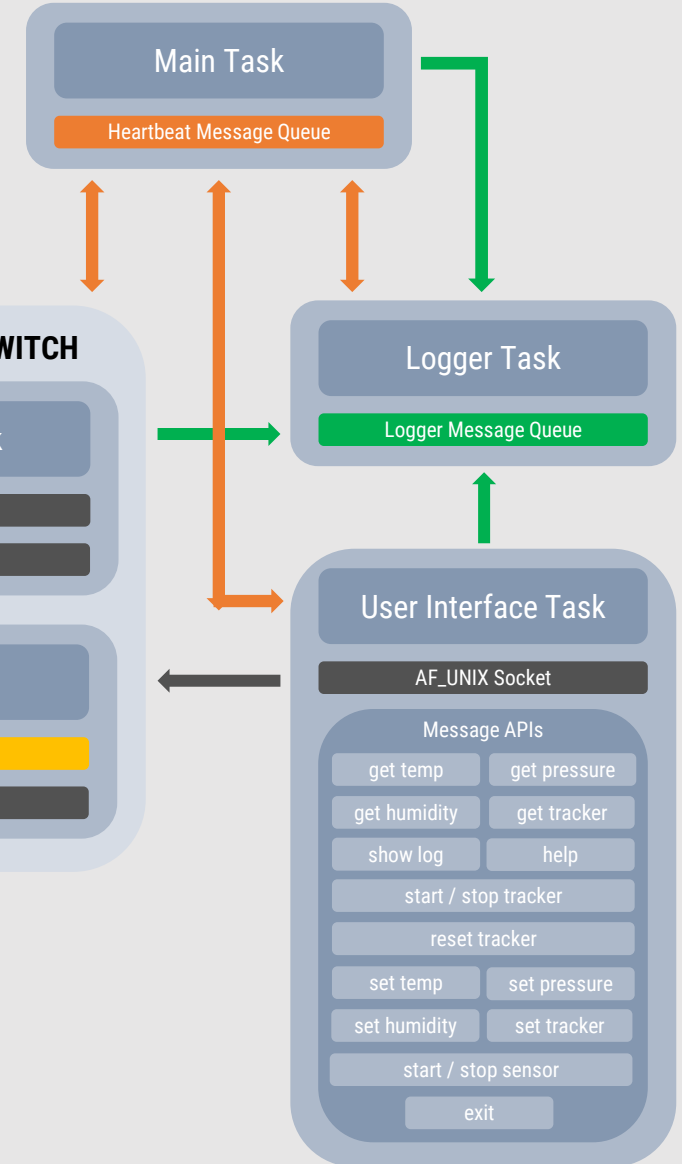
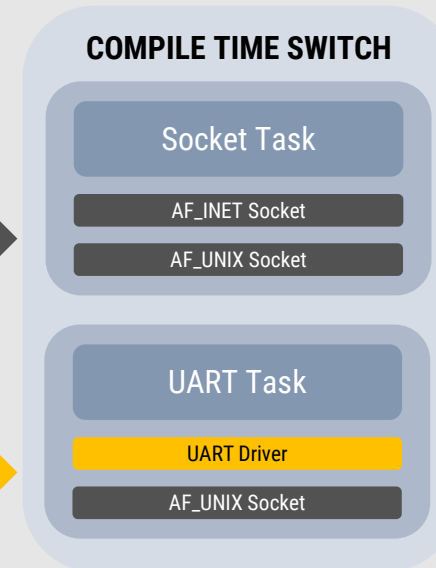
PROPOSED

BeagleboneGreen Debian Linux



ETHERNET

UART



USER FIRMWARE / TASKS

FREE RTOS LIBRARY

PERIPHERAL DRIVER LIBRARY INTERFACE

HARDWARE ABSTRACTION LAYER / PERIPHERAL DRIVER LIBRARY

USER SPACE

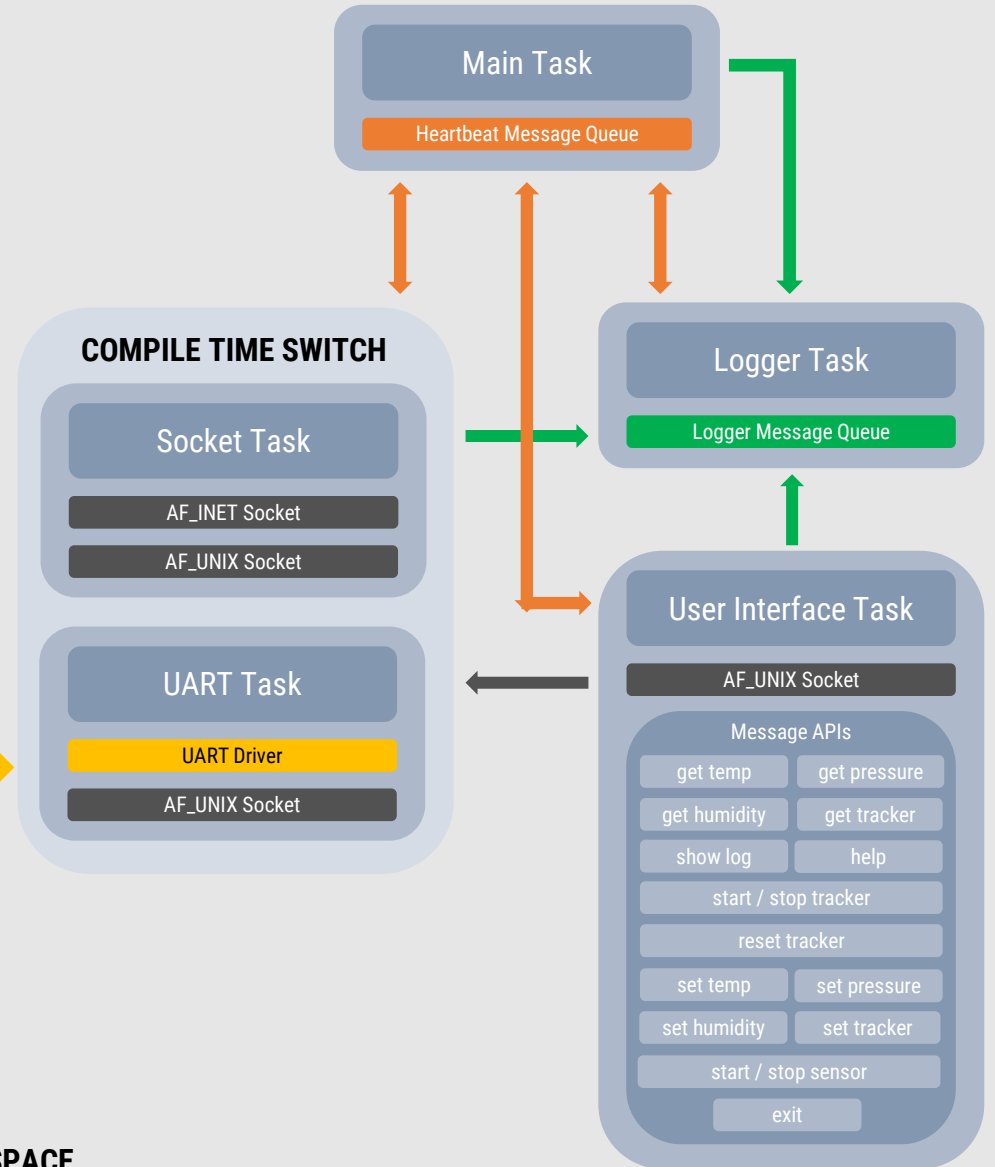
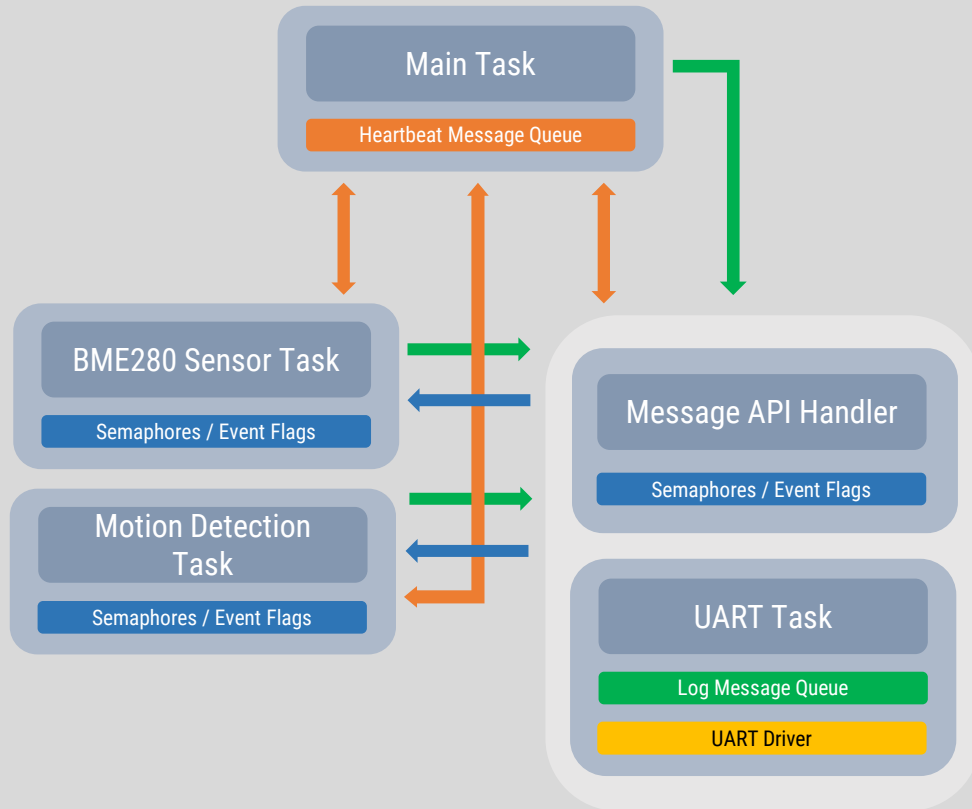
SYSCALL INTERFACE

LINUX KERNEL

TIVA FreeRTOS

ACCOMPLISHED

BeagleboneGreen Debian Linux



USER FIRMWARE / TASKS

FREE RTOS LIBRARY

PERIPHERAL DRIVER LIBRARY INTERFACE

HARDWARE ABSTRACTION LAYER / PERIPHERAL DRIVER LIBRARY

USER SPACE

SYSCALL INTERFACE

LINUX KERNEL

ECEN 5013 – APES – PROJECT 2

Sandeep Raj Kumbargeri & Prithvi Teja Veeravalli

Sensors

1x BME280 – Humidity, Pressure, Temperature Sensor

2x HS-SR04 – UltraSonic Range Finder

Application

Notifying real-time external weather conditions and detecting count of people going in and out of the place to the Beaglebone.

Triggering on events that cross sensor/count and indicating to the Beaglebone.

Also logs events as well as timely acquisition data.

Supports message APIs for the user to set the threshold and get the sensor/count data from the TIVA board.

Supports UART on *both the sides.

Allow user to configure sensor parameters through message APIs.

HC-05 Bluetooth module replaces wired UART communication with wireless Bluetooth.

Additional logging capability on TIVA using Smartphone terminal.

*UART works independently on both sides (has not been integrated)