# Project Objectives

In this project you will connect an LED to a Raspberry Pi's General-Purpose Input/Output (GPIO) header and control the LED using a cFS app.  It allows cFS developers to gain experience with using a library and app to interface and control an external hardware component using low-cost materials.

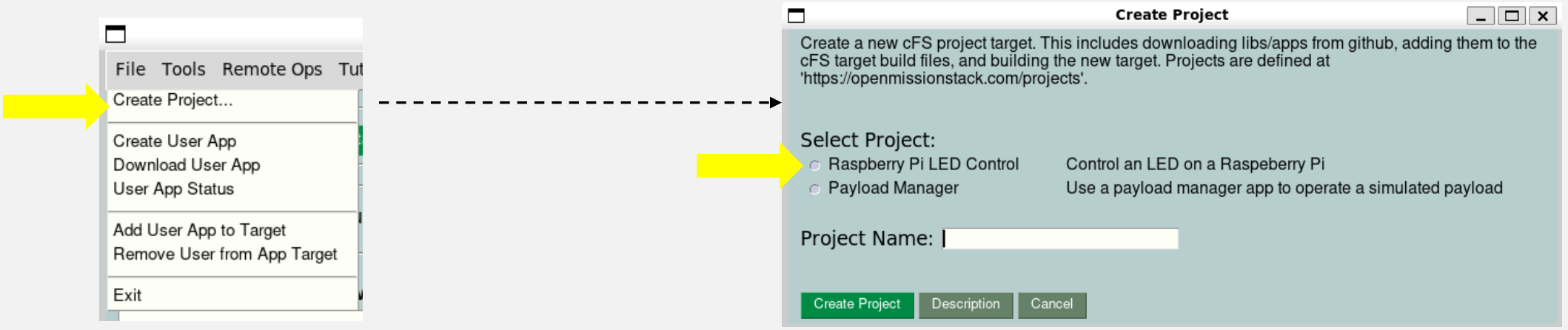
Detailed project instructions with videos can be found at

https://openmissionstack.com/projects_read/gpio_demo


Update URL after Space Steps
refactor and gpio_demo => rpi_led

# Installing & Running the Project

1. Create RPI LED project using the Create Project tool

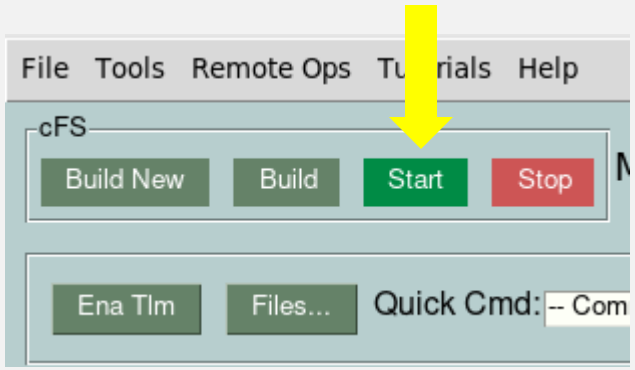



2. Before restarting Basecamp GUI, set basecamp.ini configurations to start the cFS with elevated permissions. The password needs to match your Raspberry Pi password

```
[CFS_TARGET]
# Define the default c
# in cfs-basecamp/cfe-
MISSION_EDS_NAME = bas
CPU_EDS_NAME = cpu1
BASE_PATH = ../../cfe-
# SUDO_START_CFS - Tru
SUDO_START_CFS = True

[APP]
DEBUG = False
VERSION = 2.0
EVENT_LOGS = logs/ever
DEFAULT_DOC = basecamp
# User password of acc
PASSWORD = cfs
```

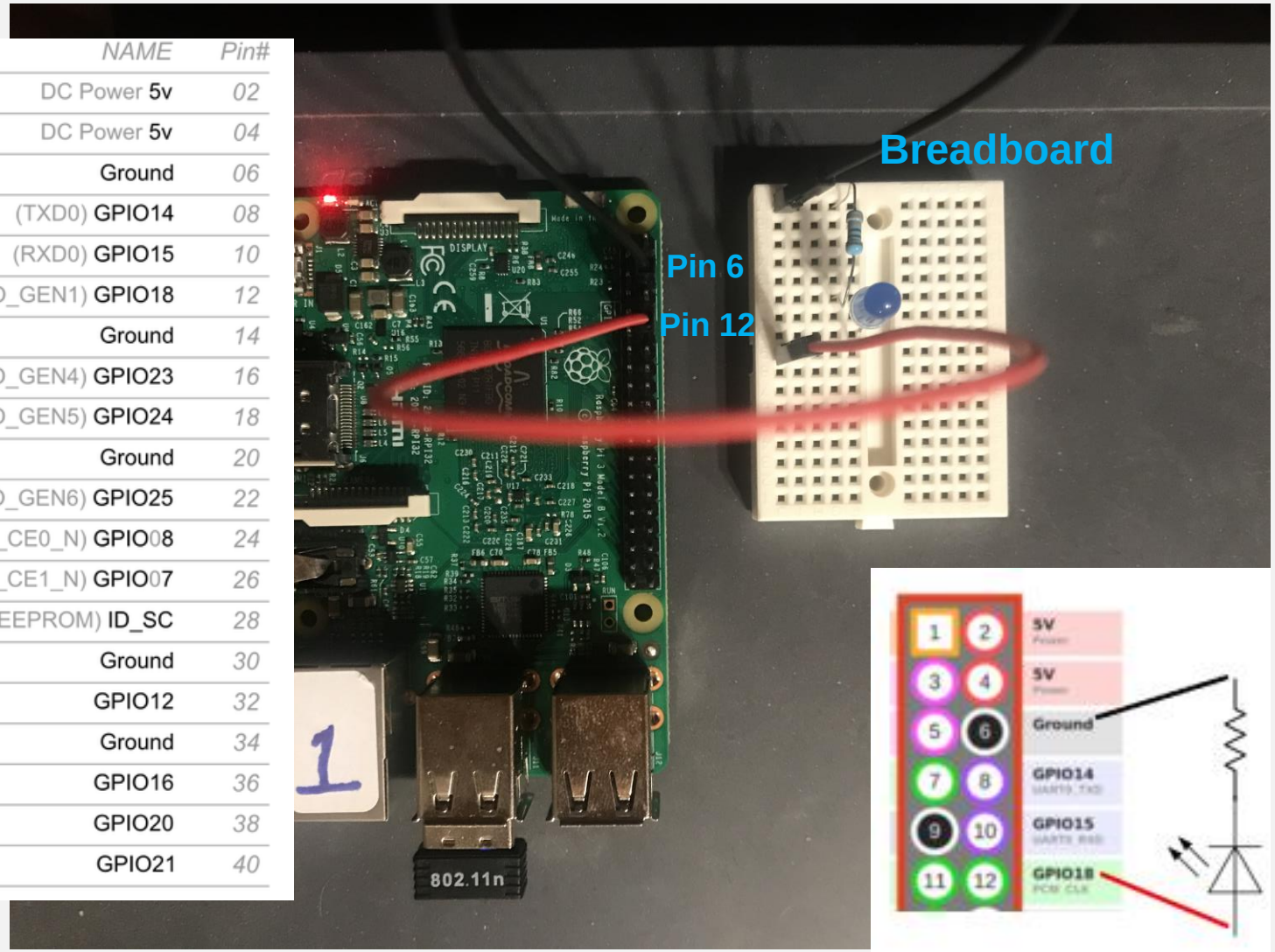
3. Start the cFS



## Configure and connect a breadboard to the Pi as shown below

- Note physical pin 12 is logical GPIO pin 18 which is the identifier used by the FSW

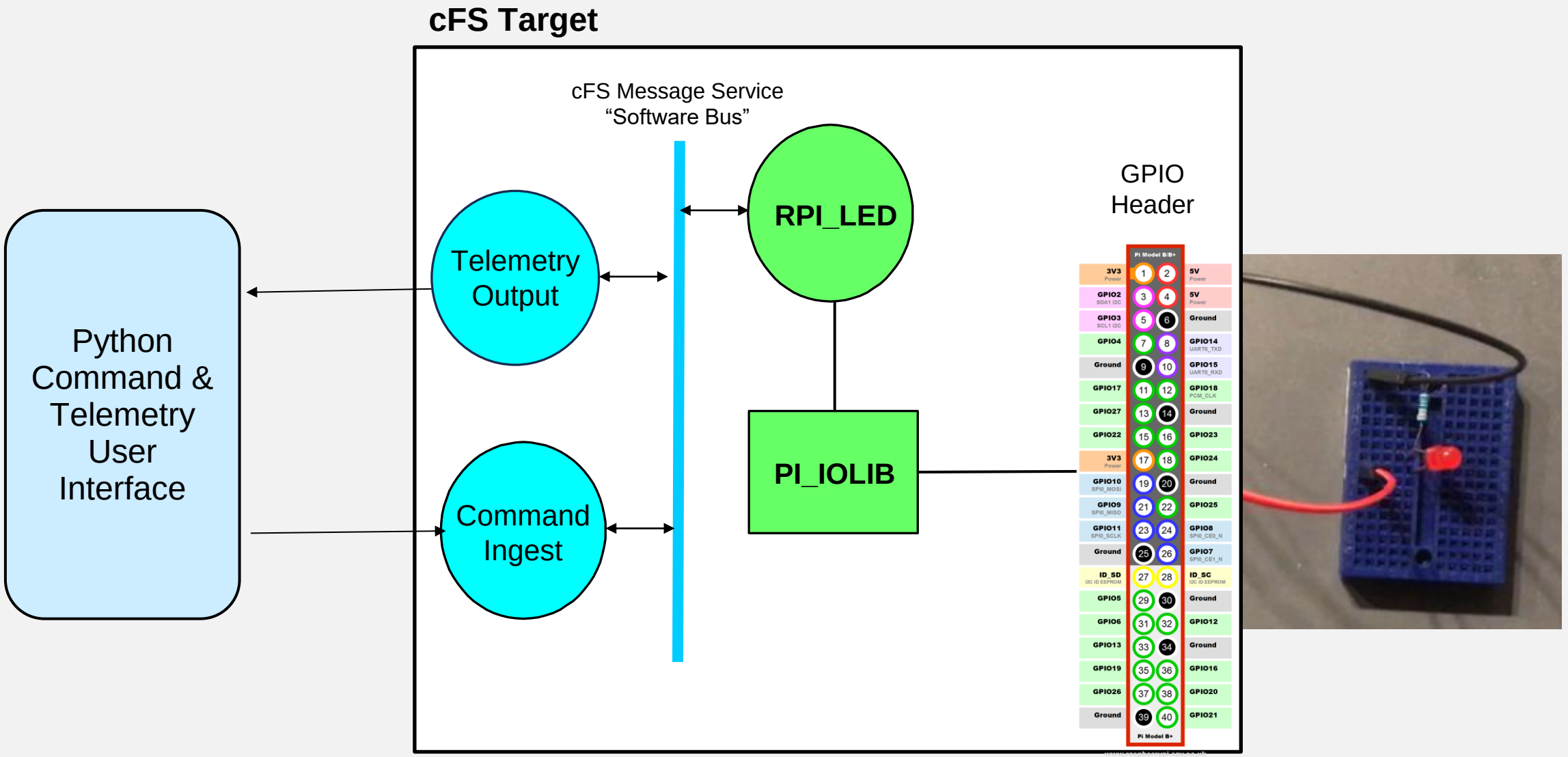
| Pin# | NAME | | NAME | Pin# |
|---|---|---|---|---|
| 01 | 3.3v DC Power | | DC Power 5v | 02 |
| 03 | GPIO02 (SDA1 , I2C) | | DC Power 5v | 04 |
| 05 | GPIO03 (SCL1 , I2C) | | Ground | 06 |
| 07 | GPIO04 (GPIO_GCLK) | | (TXD0) GPIO14 | 08 |
| 09 | Ground | | (RXD0) GPIO15 | 10 |
| 11 | GPIO17 (GPIO_GEN0) | | (GPIO_GEN1) GPIO18 | 12 |
| 13 | GPIO27 (GPIO_GEN2) | | Ground | 14 |
| 15 | GPIO22 (GPIO_GEN3) | | (GPIO_GEN4) GPIO23 | 16 |
| 17 | 3.3v DC Power | | (GPIO_GEN5) GPIO24 | 18 |
| 19 | GPIO10 (SPI_MOSI) | | Ground | 20 |
| 21 | GPIO09 (SPI_MISO) | | (GPIO_GEN6) GPIO25 | 22 |
| 23 | GPIO11 (SPI_CLK) | | (SPI_CE0_N) GPIO08 | 24 |
| 25 | Ground | | (SPI_CE1_N) GPIO07 | 26 |
| 27 | ID_SD (I2C ID EEPROM) | | (I2C ID EEPROM) ID_SC | 28 |
| 29 | GPIO05 | | Ground | 30 |
| 31 | GPIO06 | | GPIO12 | 32 |
| 33 | GPIO13 | | Ground | 34 |
| 35 | GPIO19 | | GPIO16 | 36 |
| 37 | GPIO26 | | GPIO20 | 38 |
| 39 | Ground | | GPIO21 | 40 |




**220 Ohm Resister**
*(red, red, brown)*

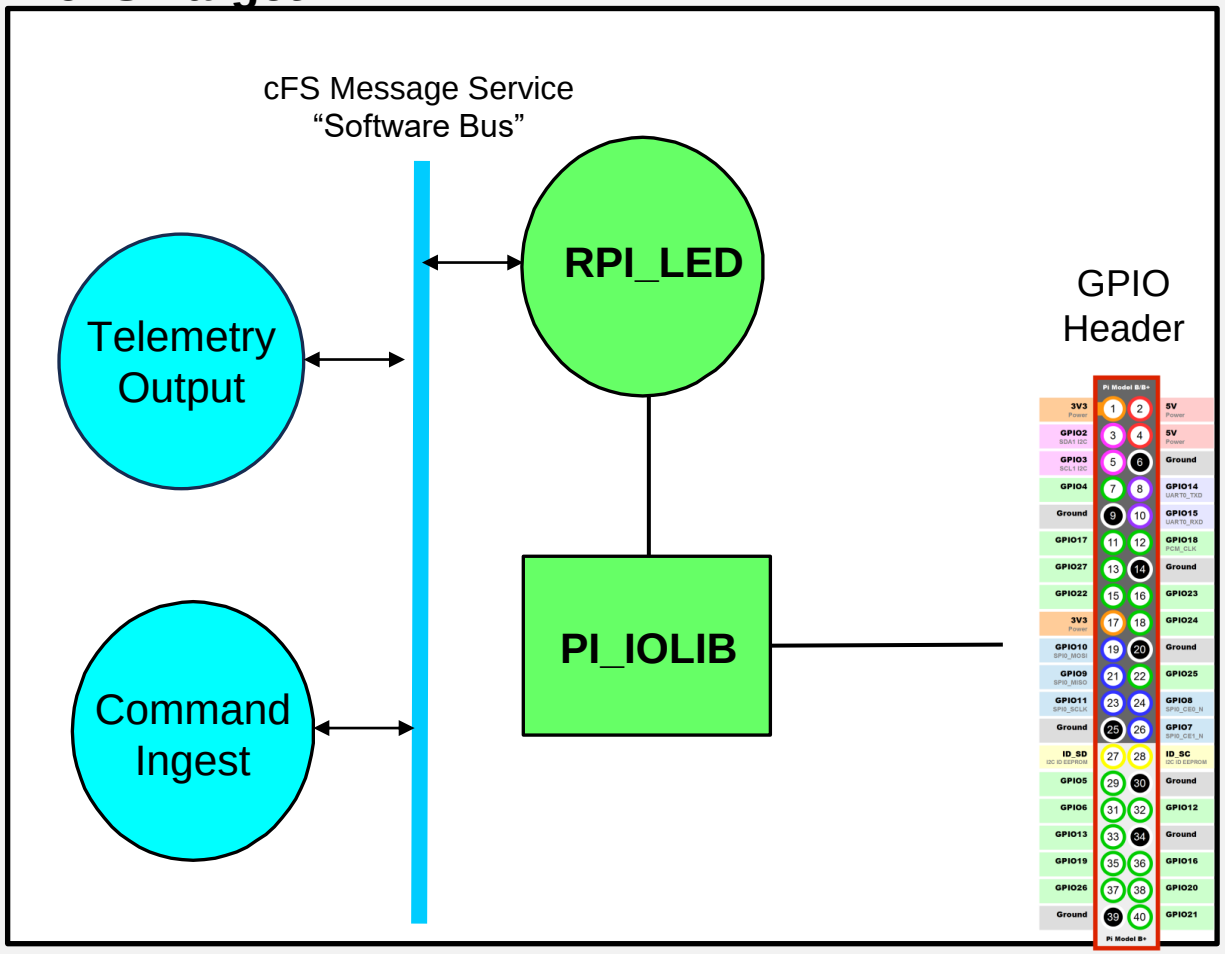
**LED**
- *Connect shorter leg Cathode (-) to resistor*
- *Connect longer leg Anode (+) to GPIO pin 12*

# Connect LED to RPI GPIO header


cFS Target
cFS Message Service
“Software Bus”
Python
Command &
Telemetry
User
Interface
Telemetry
Output
Command
Ingest
RPI_LED
PI_IOLIB
GPIO
Header
= Project Apps and Library


# Update GUI after gpio_demo => rpi_led refactor


## cFS Target




# RPI_LED App

## Commands

- Set LED On Time
- Set LED Off Time

## Telemetry

```
HkTlm.Payload.ValidCmdCnt  : 0
HkTlm.Payload.InvalidCmdCnt: 0
HkTlm.Payload.CtrlIsMapped : FALSE
HkTlm.Payload.CtrlOutPin   : 18
HkTlm.Payload.CtrlLedOn    : FALSE
HkTlm.Payload.CtrlSpare    : 0
HkTlm.Payload.CtrlOnTime   : 3000
HkTlm.Payload.CtrlOffTime  : 6000
```

# Library and Application Summary

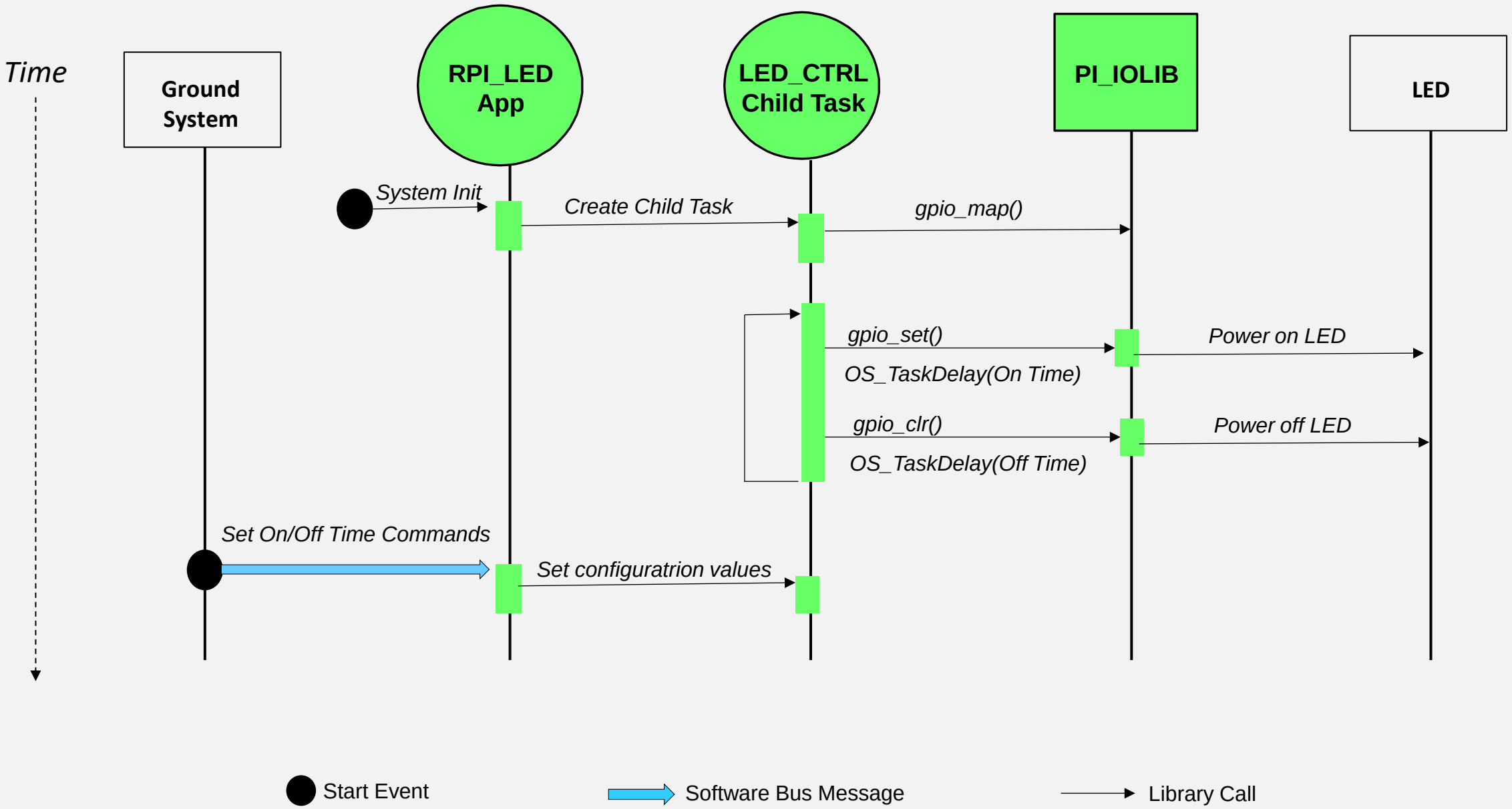
## PI_IOLIB

- This library adapts the “minimalistic peripheral access” (MIPEA) library for the Raspberry Pi, https://github.com/jasLogic/mipea so it can serve as a cFS library.
- It provides an interface to the Rasperry Pi’s memory mapped General Purpose I/O registers
- The config.h configuration file allows you to select your Broadcom processor chip

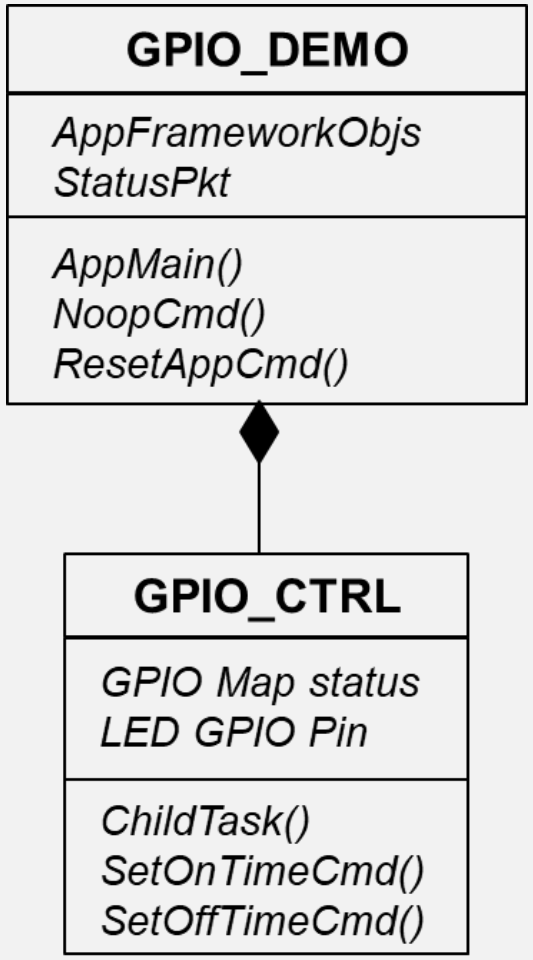
## RPI_LED

- The main app manages the ground command and telemetry interface
- A child task controls turning on and off the LED
- Ground commands can be sent to set the LED on and off time durations
- JSON initialization table defines the GPIO LED control pin and the default LED on/off time durations

# Control Flows



# RPI_LED App Object Design




## RPI_LED

- Manages app initialization, main runtime loop, and status telemetry
- Dispatches commands to objects



## LED_CTRL

- Manages GPIO and LED interface
- Contains child task that turns the LED on and off
- Calls to PI_IOLIB functions should be limited to this object to localize coupling

# RPI_LED Control Flow