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ENSE 481

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ENSE 481 Test Plan

Requirements

- I shall configure an Nucleo-F103RB (Nucleo) for programming with its associated ST-LINK module detached for better power consumption measurements
 - Break the MCU from the ST-LINK module, connect SWD programming lines, VDD and ground connections for development and programming. When performing a test, fully disconnect the ST-LINK SWD wires, leaving only VDD and ground.
- I shall discuss freeRTOS compatibility with sleep modes
- I should implement tickless freeRTOS sleep
 - Use CLI for this
- I shall configure the Nucleo in near maximum power consumption (PC) mode to be used as an upper bound of possible PC
 - Enable all clocks, peripherals and all other functions. ~~Enter a deadloop for a few seconds.~~ Use builtin `HAL_Delay`
 - Do this incrementally for easier power note taking
- I shall configure the Nucleo in a “typical” PC mode as a control
 - Default configuration of program which contains USART1, TIM3 (HAL) and ADC1 enabled.
- I should configure the Nucleo in a lowest possible while-still-functional PC mode where lowest power is achieved with no built in low power modes used (turn off all clocks as possible, CPU clocks remain on)

- All peripherals disabled. Further research needed for what else can be disabled while the CPU is still active. ~~If program is too similar to the “typical” test, this one will be removed~~
- I shall configure the Nucleo in **Sleep-now** and **Stop** modes (AN2629)
 - One test for **Sleep-now** and **Stop** mode respectively. Verify mode is entered via power measurements near expected values when entering sleep mode, and when interrupt (blue button) fires, waking the CPU
- I shall measure power consumption in the mW range for all above mentioned modes
 - Power measurements should align in direction as expected shown in Table 1. Measurements then posted to a chart, with data including min, max and avg for each test
 - Using the Joulescope
- I shall compare and assess the various above mentioned modes qualitatively for their difficulty in implementation and effectiveness
 - Create a chart of subjective difficulty in implementation of various methods.
- ~~● I should calculate minimum theoretical power consumption for all above mentioned modes~~
 - ~~○ Using datasheets? *Was the intention, I took it meaning that it would be focused more on the data I have collected.*~~
- I should configure the Nucleo in **Standby** mode (AN2629)
 - Should not be difficult, Standby mode is more of a reset-to-recover mode, so it should be compatible with all
- ~~● I should investigate other algorithms for low PC that do not use built in low power modes~~

- ~~More research is needed~~
- I should determine the incremental power consumption of all **stm32f103rb** peripherals by subtracting the power with the peripherals on and the power with all peripherals on.
 - For all peripherals, first measure “typical power” with all peripherals off, then for each turn it on measure power. Then subtract to obtain the incremental power used by the peripheral.
- I should use an existing project or code and determine its current power consumption, and attempt to use methods to minimize its power consumption, then measure the power.
 - Shunt resistor power measurement

Test Name	Expected Power consumption order (higher = more power)
Max PC	highest
“typical”	4
Lowest while-still-functional	3
Sleep	2 (less power by a factor of 5? Compared to typical?)
Stop	1
Standby	Lowest

Table 1: Estimated power consumption test alignment