Karim Ait-Allaoua

ENSE 481

5 February 2024

ENSE 481 Project Plan

Project Description

I will study and investigate low power design of the `stm32f103` lineup of microcontrollers (MCU's). More and more electronics keep getting smaller and from that the desire to incorporate them on items such as wearables (or any other battery operated device) grows with the passing years. As such the universal agony that is your battery operated device needing a recharge, or simply the battery life not meeting expectations occurs more than it should from my experiences. Coupled with the fact that highly capable (thereby potentially high power consuming (assuming all peripherals used, etc)) 32 bit MCU's are growing in global markets (Alsop, 2022), understanding how to optimize for low power consumption needs to be in the toolkit of all embedded developers.

Requirements

- I shall configure an Nucleo-F103RB (Nucleo) for programming with its associated ST-LINK module detached for better power consumption measurements
- I shall configure the Nucleo in near maximum power consumption (PC) mode to be used as an upper bound of possible PC
- I shall configure the Nucleo in a "typical" PC mode as a control

- 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)
- I shall configure the Nucleo in `Sleep-now` and `Stop` modes (AN2629)
- I shall measure power consumption in the mW range for all above mentioned modes
- I shall compare and assess the various above mentioned modes qualitatively for their difficulty in implementation and effectiveness
- I should calculate minimum theoretical power consumption for all above mentioned modes
- I should configure the Nucleo in `Standby` mode (AN2629)
- I should investigate other algorithms for low PC that do not use built in low power modes

Scenario

Since this is more of a research and investigation, a scenario of a user interacting with my project is not necessarily applicable. However, all source code and project results will be available online publicly for reading. As such, the only possible scenario is a user could attempt to replicate my results via cloning, building, flashing and measuring the various PC tests.

Functional Components

- Computer with serial terminal: a laptop with putty or similar serial to usb program to send serial commands to nucleo
- Power measurement device: TBD how I will measure this, Doug mentioned he had one that may work

- Nucleo: Software subsystems
    - CLI: allow user to choose which specific test to run
    - Test functions: called when the chosen test is to be run. Will involve use of interrupts, either external GPIO or communications such as I2C to wake in case of built in sleep modes.

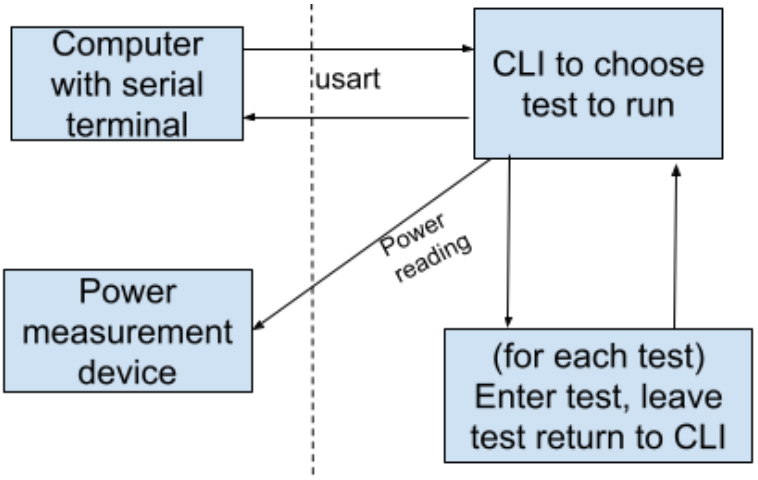

Figure 1: Block Diagram of System

References

Alsop, T. (2022). *Global microcontroller market size by type 2021*. Statista. https://www.statista.com/statistics/553426/worldwide-microcontroller-unit-market-size/