Project Name: Power Usage Monitor for Battery Powered Devices

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Project Motivation

The emerging and fast-growing Internet of Things is placing a growing number of devices at remote locations where they function as sensors and operate "off the grid," without traditional connectivity or power. Connectivity is typically provided via the cellular network, and power comes from batteries. (Other reasons for relying on battery power include safety and/or economy.) While the cellular network provides its own power and is extremely reliable, battery-based power for the devices themselves can be problematic. Changing demands can drain batteries, leaving a system "powerless" with little or no warning.

Because power is essential to the functioning of the device, monitoring and profiling power consumption is critical. Without accurate, up-to-the-minute battery profiling, power can be lost unexpectedly, crippling the device. As a significant "player" on the Internet of Things and developer of innovative, often remotely located products, NimbeLink knows the importance of reliable battery power.

The purpose of this project is to develop an intelligent power monitor for battery-operated systems. The monitor will be designed around an embedded microcontroller that will generate a power usage profile for the associated battery. The system may be called upon to report information via the cellular network and must be able to monitor current spikes associated with cellular transmissions.

Project goals

-Analyze the current profile of a cellular modem to determine the correct sampling frequency
-Design a device that can accurately measure voltage and current simultaneously
-Log the power calculations to an onboard SD card
-Monitor is able to generate a power profile of a cellular device supplied by Nimbelink.

Project Specifications

1) Device must measure voltage and current simultaneously
2) Variable gain settings for Voltage/current in order to measure uA - Amps
   Preferable set gain in software not a jumper
3) Software Output of:
   a. max, min, Average Voltage
   b. max, min, average current
   c. max, min, average power
4) The max, min, average value calculations should be user started/reset by push buttons.
5) Sampling must be at least fast enough to capture GPRS pulse sequence (>20kHz sample Rate)
6) Easy wire terminals to attach unit to test
7) MCU UART debug port and JTAG/SWD programming port
8) Parasite power itself off of the test unit, but that power should not be included in the test measurement
9) Ability to save and export data points to SD card in csv file format, or output to USB
10) All measurements are time stamped (this can be time relative to the start of the test)

11) Use an embedded processor (eg. STM32F4, PIC, etc..)
12) PCB and all connectors housed in a case

Stretch goals

1) External trigger to start/stop the Max, min, average values
2) Add optional common power connectors to pass thru (USB, 5V barrel jack, etc)
3) Jumper setting to Power the board off a separate supply
4) External Display showing, max, min, average

Describe the demonstration that you expect the students to perform at the design show in mid December.

Students will be expected to demonstrate a standalone power monitoring solution that can generate a power profile of a cellular device and log the data to an SD card or USB drive.

Are there specific courses that the students must have had to be successful at this project?

Embedded Systems
C Programing
Analog Circuits
Circuit Design
Signal Analysis
Solar Car

Will an IP agreement be required?

Yes
