CSE4342 Embedded Systems II
CSE5442 Embedded Systems
Low Power Location Data Logger with Wear Leveling
Fall 2019 Project

1 Overview

The goal of this project is design a system capable of periodically measuring location and environemental data and writing data to flash memory, using wear leveling techniques. The solution is also designed to be power efficient so that it can run for extended time on a single battery charge depending on the configuration.

The project shall provide a complete user interface through the virtual COM port on the evaluation board to configure the device and retrieve the stored data.

A collection of most major parts will be provided.. The pc boards, tools, and any optional items are not included in this collection of parts.

2 Hardware Description

Microcontroller:
An ARM M4F core (TM4C123GH6PMI microcontroller) is required.

Activity LED:
The green on-board LED will be used as an activity indicator.

Serial interface:
If using the EK-TM4C123GXL evaluation board, then the UART0 tx/rx pair is routed to the ICDI that provides a virtual COM port through a USB endpoint.

Real-time clock:
The on-board RTC will be used to time-stamp data samples.

Sensors:
The external sensor used in this project is an MPU9250. The SPI and interrupt lines should be connected with the TM4C123GH6PMI.

The bandgap temperature sensor in the TM4C123GH6PMI ADC can also be used as a source of temperature.

3.3V supply:
The circuit is powered completely from the 3.3V regulator output on the evaluation board.

3 Suggested Parts List

Part	Quantity
MPU9250 9-dof Sensor	1
1x10 SIP socket	1
2.2kohm, 1/4W resistor (pullups on SCL/SDA)	2
2x10 double-row header, unshrouded	2
Wire (22-24 AWG solid wire, 3+ colors)	1
PC board (approx 3.5x5”)	1
Tools, safety glasses, …	1 each
Sensor	Varies

4 Software Description

A virtual COM power using a 115200 baud, 8N1 protocol with no hardware handshaking shall be provided with support to the following commands.

Debug:

If “reset” is received, the hardware shall reset.

If “temp” is received, the hardware shall return the internal temperature value.

Configuration (sent before the “periodic” and “trigger” commands):

If “time H M S” is received, then the time should be set.

If “time” is received, the current time should be shown on the virtual COM port.

If “date M D” is received, then the date should be set.

If “date” is received, the current date should be shown on the virtual COM port.

If “log compass” is received, then the hardware should log sensor outputs from the magnetometer.

If “log accel” is received, then the hardware should log sensor outputs from the accelerators.

If “log gyro” is received, then the hardware should log sensor outputs from the gyro sensors.

If “log temp” is received, then the hardware should log sensor outputs from the temperature sensor.

You are free to change the log arguments as needed to add more sensor values.

If “samples N” is received, then configure to acquire N sample sets when the capture starts.

If “gating PARAMETER GT|LT VALUE” is received, the trigger is conditional on the paramater being greater than or less than the value (you should select the parameters supported, such a temperature, absolute acceleration, etc.

If “hysteresis PARAMETER H” is received, the threshold hysteresis for the parameter will be set to H.

If “sleep on” is received, the hardware should power-down to the lowest possible power consumption possible when not sampling, including de-powering the DAC in period sample mode. In this mode, the

RTC can be used to wake the processor for periodic sampling. When in triggered mode, the DAC and internal ADC module must be kept in a powered-up state.

If “sleep off” is received, the hardware should stay powered up between samples. This is the default mode.

If “leveling off” is received, wear leveling should not be used. This is the default mode.

If “leveling on” is received, wear leveling should be used.

Sample control:

If “periodic T” is received, configure the hardware to take N samples with an inter-sample delay of T milliseconds.

If “trigger” is received, configure the hardware to take N samples when the condition is true occurs (this is only for voltage sampling). Each of the samples will be taken when the comparator edge condition occurs if the hysteresis requirement (if any) has been satisfied between samples.

If “stop” is received, stop all sampling of data.

Data access:

You can use the on-board SW2 or similar input to wake the processor if it is in sleep mode.

If “data” is received, the board will output the internal record of the sampled data along with time the data is sampled and the value in a tabbed separated table of values. You should have a way to display this information on a PC.

5 Testing

Your hardware will be tested in the ERB 127 lab.

Computers and lab equipment will be provided on campus in ERB 127 for you to work on this project. If you do plan on plugging your project into your own machine, do so at your own risk and only after testing the hardware. Again, you are responsible for anything that happens to your personal machine.

6 Deadlines

The final project is due on the date and at the time indicated in the syllabus, with an oral defense, electronic copy of your code and report, hard copy of your code, and demonstration of hardware and software (including compilation on site). The project teams consist of 1 or 2 members. All code must be unique and written solely by the student submitting the project.

7 Safety Issues

Please follow all UTA safety rules and those stated in the syllabus.

Please utilize the supervised lab resources in ERB 127 when working on the project for your safety. You may only use the resources in ERB 127 when the grader or other CSE staff is present.

Have fun!