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Microcontroller Based Weather Data Logger

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Abstract

Data logger periodically measures various real-time meteorological parameters and stores for future use. The Microcontroller based automatic weather Data Logger is arranged that it can automatically operate unattended for long periods up to few years. The system has its own automatic power generation from battery backup for maintenance and storage to achieve the uninterrupted operation. The proposed set up consists of four sensors (to monitor and store air temperature, relative humidity, leaf wetness and soil moisture content) interfaced with a 32-bit micro controller. The developed system is tested and the results are discussed.

Keywords: Data logger, Data Acquisition System (DAQ), Serial Peripheral Interfacing (SPI), Sensors.

Introduction

Data acquisition is gathering of information about a system or process. It is the process of collecting data in automated fashion from analog or digital measurement sources such as sensors and devices under test. Before the computer age, most data was recorded either manually or on strip chart recorders. With the advancement of technology, the processes are becoming more and more complex increasing the number of parameters for data acquisition. Many new generation data acquisition products have been developed due to emergence of microcontroller that enables real-time data gathering, analysis, logging and viewing of data.

Overview

A weather data logger measures various real-time metrological parameters and logs (stores) for future reference. In this paper the development of an efficient and weather data logger is discussed. The system is designed and developed to measure the parameters Air Temperature, Relative Humidity, leaf wetness and Soil moisture with the help of sensors and the results are stored in the on board memory of microcontroller LPC2478for post process analysis. In case of need, based on requirement suitable size external memory can be interfaced with the system. The data logger is arranged to automatically operate unattended for prolong period up to few years. The system necessarily has its automatic power from battery backup for maintenance and storage system. In addition a solar panel also can be used to power system.

Details of Proposed Scheme

The sensors employed are Rm young for air temperature, Rm young for relative humidity, Devis for leaf wetness and Delta T M for soil moisture. The ADC is interfaced to the controller along with external signal conditioner. The LPC 2478 is a 32bit microcontroller with RISC architectureARM7TDMI-S CPU core with real-time debug interfaces that include both JTAG and embedded Trace. It has 512 KB of on-chip high-speed Flash memory. This Flash memory includes a special 128-bit wide memory interface and accelerator architecture that enables the CPU to execute sequential instructions from Flash memory at the maximum 72 MHz system clock rate.

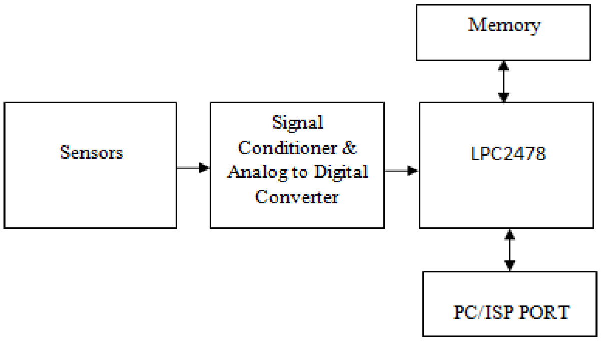
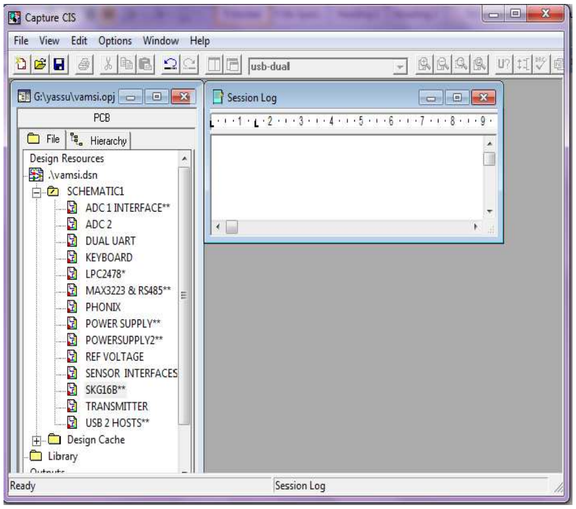


Fig1: Block Diagram of Weather Data logger

To prepare the PCB board for the data logger OrCAD Capture CIS software tool is used for circuit schematic capture. It is part of the OrCAD circuit design suite. Capture CIS is nearly identical to the similar OrCAD tool, Capture.

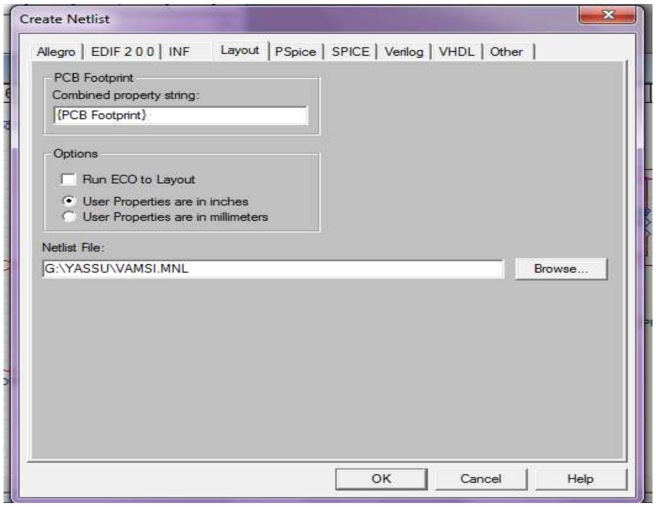
The difference between the two tools comes in the addition of the component information system (CIS). The CIS links component information, such as printed circuit board package footprint data or simulation behavior data, with the circuit symbol in the schematic. When exported to other tools in the OrCAD design suite, the data stored in the CIS is also transferred to the other tool. Thus, when a design engineer exports a schematic to the circuit board layout utility, the majority of the circuit elements have footprints linked to them. This saves time for the design engineer.

After designing the schematics we have to create the net list file for the schematics. Using the net list file we generate the layout for board. For designing layout we use LAYOUT PLUS tool. Before creating the net list file we have to create the foot prints for the components using the library manager. After creating the net list file, open the file using tool LAYOUT PLUS. OrCAD Layout is a powerful printed circuit board layout tool that is a part of a full line of design and simulation tools available from OrCAD. OrCAD Layout makes it easy to place, route and prepare printed circuit boards for fabrication.



Design Resources
.\vamsi.dsn
SCHEMATIC1
ADC 1 INTERFACE**
ADC 2
DUAL UART
KEYBOARD
LPC2478*
MAX3223 & RS485**
PHONIX
POWER SUPPLY**
POWERSUPPLY2**
REF VOLTAGE
SENSOR INTERFACES
SKG16B**
TRANSMITTER
USB 2 HOSTS**
Design Cache
Library

Fig. 2a: Screen shot of CAPTURE CIS



PCB Footprint
Combined property string: {PCB Footprint}

Options
□ Run ECO to Layout
● User Properties are in inches
○ User Properties are in millimeters

Netlist File: G:\YASSU\VAMSI.MNL

Fig. 2b: Screen shot of how to generate net list

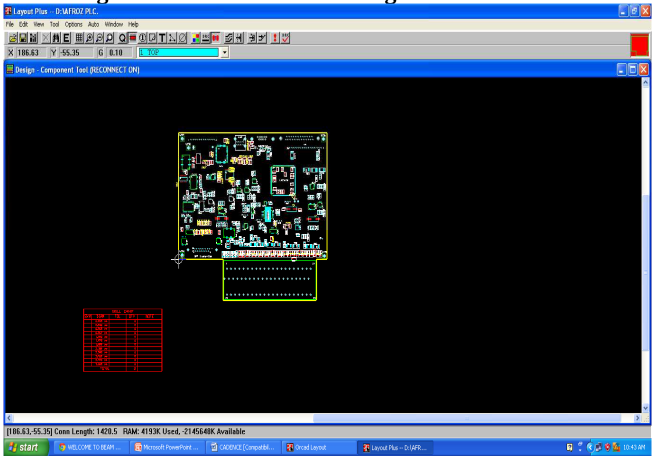
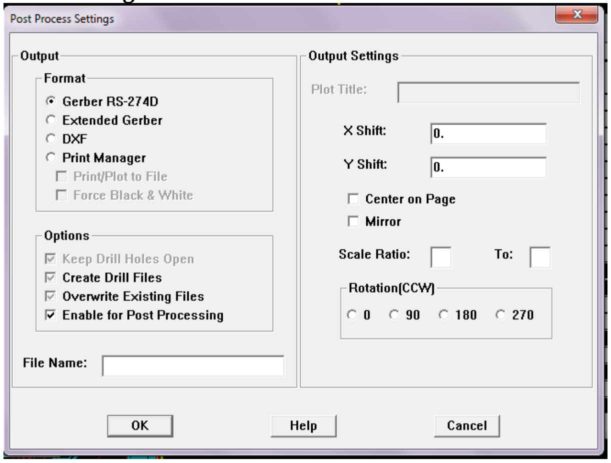


Fig. 2c: Screen shot of LAYOUT PLUS



Output

Format
● Gerber RS-274D
○ Extended Gerber
○ DXF
○ Print Manager
□ Print/Plot to File
□ Force Black & White

Options
☑ Keep Drill Holes Open
☑ Create Drill Files
☑ Overwrite Existing Files
☑ Enable for Post Processing

File Name:

Output Settings

Plot Title:
X Shift: 0.
Y Shift: 0.
□ Center on Page
□ Mirror
Scale Ratio: To:
Rotation(CCW)
○ 0 ○ 90 ○ 180 ○ 270

Fig. 3: Gerber films generation file

After finishing placement and routing the Gerber films for the design are generated, and given to PCB manufacture. These stages are shown in figures 2a-2d and 3. The final PCB board of data logger is shown in fig 4.

The IDE used for code writing is Ecplice and Embedded C language is used to write code. Flash magic is used to dump on the target board and the setup is shown in figure 5. SPI interface is used in the weather data logger.

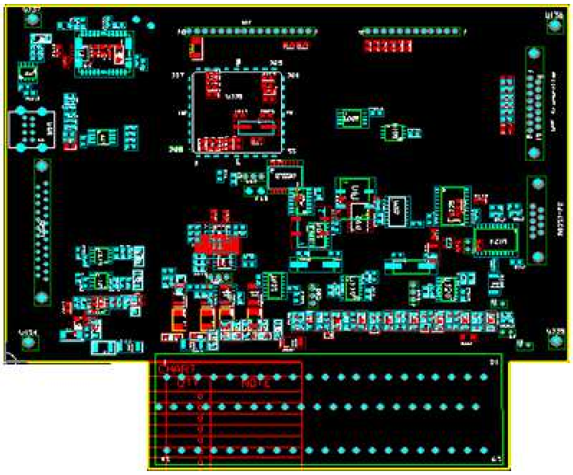
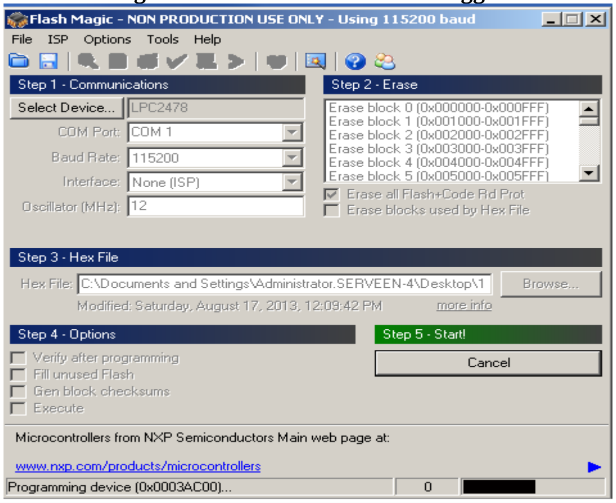


Fig. 4: Final PCB board of data logger



Flash Magic - NON PRODUCTION USE ONLY - Using 115200 baud
File ISP Options Tools Help

Step 1 - Communications

Select Device... LPC2478
COM Port: COM 1
Baud Rate: 115200
Interface: None (ISP)
Oscillator (MHz): 12

Step 2 - Erase

Erase block 0 (0x000000-0x000FFF)
Erase block 1 (0x001000-0x001FFF)
Erase block 2 (0x002000-0x002FFF)
Erase block 3 (0x003000-0x003FFF)
Erase block 4 (0x004000-0x004FFF)
Erase block 5 (0x005000-0x005FFF)

☑ Erase all Flash+Code Rd Prot
□ Erase blocks used by Hex File

Step 3 - Hex File

Hex File: C:\Documents and Settings\Administrator.SERVEEN-4\Desktop\1 Browse...
Modified: Saturday, August 17, 2013, 12:09:42 PM more info

Step 4 - Options

□ Verify after programming
□ Fill unused Flash
□ Gen block checksums
□ Execute

Step 5 - Start!

Cancel

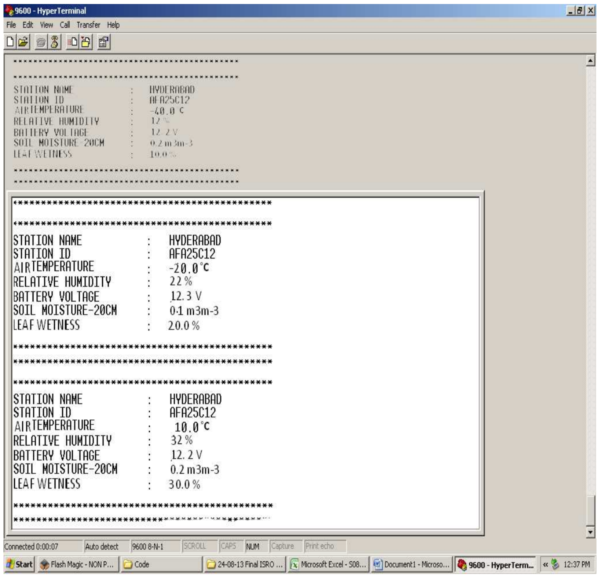
Microcontrollers from NXP Semiconductors Main web page at:
www.nxp.com/products/microcontrollers

Programming device (0x0003AC00)... 0

Fig.5 Open Flash Magic and set it up.

Results

The data logger has been developed and tested to measure the parameters air temperature, relative humidity, leaf wetness and soil moisture and the results are shown in fig 6.



```
*********************************************

*********************************************
STATION NAME          :    HYDERABAD
STATION ID            :    AFA25C12
AIRTEMPERATURE        :    -40.0 C
RELATIVE HUMIDITY     :    12 %
BATTERY VOLTAGE       :    12.2 V
SOIL MOISTURE-20CM    :    0.2 m3m-3
LEAF WETNESS          :    10.0 %

*********************************************
*********************************************

*********************************************

*********************************************
STATION NAME          :    HYDERABAD
STATION ID            :    AFA25C12
AIRTEMPERATURE        :    -20.0°C
RELATIVE HUMIDITY     :    22 %
BATTERY VOLTAGE       :    12.3 V
SOIL MOISTURE-20CM    :    0.1 m3m-3
LEAF WETNESS          :    20.0 %

*********************************************
*********************************************

*********************************************
STATION NAME          :    HYDERABAD
STATION ID            :    AFA25C12
AIRTEMPERATURE        :     10.0°C
RELATIVE HUMIDITY     :    32 %
BATTERY VOLTAGE       :    12.2 V
SOIL MOISTURE-20CM    :    0.2 m3m-3
LEAF WETNESS          :    30.0 %

*********************************************
*********************************************
```

Connected 0:00:07 Auto detect 9600 8-N-1 SCROLL CAPS NUM Capture Print echo

Fig 6: Display of desktop based monitoring system for Weather Data logger

Conclusion

A data logger has been developed and tested. In general Data Logger acquires the data of parameters continuously and stores the average value on hourly basis. Hence the memory capacity is of prime importance. Before the memory is full user has to take the backup of data and clear memory to prevent overwriting and loss of the old data. In addition, one can use an external memory to increase the overall storage space.

References

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[9] http://www.ece.unm.edu/~jimp/650/doc/ekarat_layout_plus_tut.pdf
[10] https://www.egr.msu.edu/eceshop/pdf/an_pcb_2t12.pdf
[11] http://kurser.iha.dk/eit/eit-lab/orcad%20userguide.pdf
[12] http://www.nxp.com/documents/application_note/AN10897.pd
[13] http://www.ti.com/lit/ds/symlink/lm2936.pdf
[14] http://www.geoscientific.com/technical/tech_references_pdf_files/Data_Logger_Fundamentals.pdf
[15] https://www.egr.msu.edu/eceshop/pdf/an_pcb_2t12.pdf
[16] https://engineering.purdue.edu/ece477/Webs/S08-Grp03/docs/Using%20OrCAD%20Layout_3.pdf
[17] http://www.eng.auburn.edu/~nelson/courses/elec3040_3050/C%20programming%20for%20embedded%20system%20applications.pdf