The Development of a Code for Functionality in Multi-Level Printed Circuit Boards

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http://www.csm.ornl.gov/Internships/rams_05 abstracts/n_brabson.pdf

Abstract

Wireless sensor networking offers the opportunity to make sensor measurements in harsh environments and remote locations, collect the sensor data at a central repository, and make the data available to anyone with network access. This research project involves the integration of sensor technology, wireless communications, and computer networking. My role in the research project includes data collection and evaluation, and checking out wireless communications hardware. The hardware to be used in the evaluation was newly designed (Radio Frequency) RF boards for use in a wireless communications transceiver prototype. A software program was needed to test the boards for correct voltage tolerances (voltage check-out), accuracy in the files downloaded to the board while making sure it read back matching values (JTAG check-out), and verifying that the SPI lines on the RF board were toggling as desired (RF board check-out). An instrumentation interface was initially created in LabVIEW; however, MATLAB was chosen as the software that would be more efficient in obtaining the data that was needed. The Instrument Control Toolbox in MATLAB was necessary for communication with instruments supporting the GPIB interface. This research, in ensuring that these boards will function as intended, is just a small part of a larger project to accelerate the examination of newly designed RF boards. ORNL staff that use RF boards will conserve time and energy in determining whether the boards are working properly by using this program.

What is a Software Defined Radio?

- A radio that is substantially defined in software and whose physical layer behavior can be significantly altered through changes to its software
- Can be reprogrammed to switch from one application to another

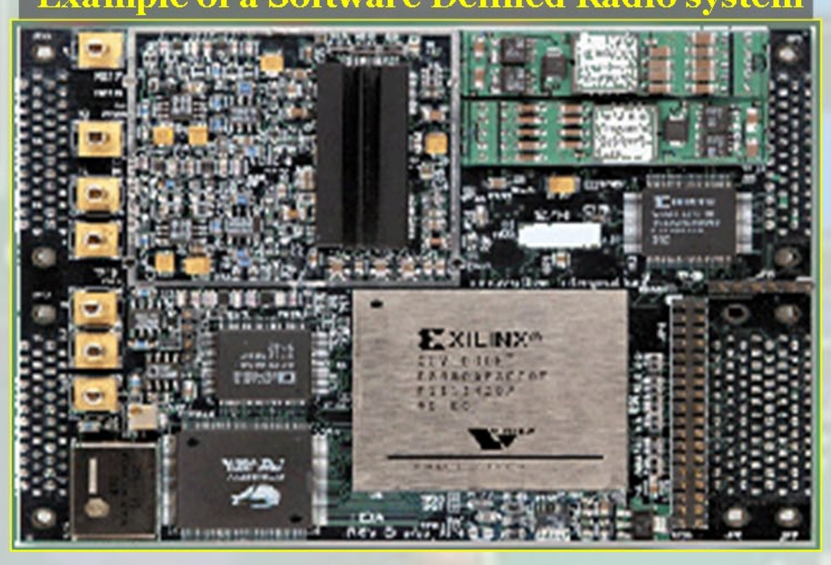
Goals in the Research

- Write a code to check for component functionality in RF boards
- Learn LabVIEW and MATLAB programming functions
- Program the code in MATLAB

Studying New Applications

- Gained knowledge about LabVIEW by studying various tutorials and manuals
- Created a program that continuously read in temperature data, kept count of how much data was collected, and graphed the data on a chart and table
- Re-learned MATLAB by studying previous files

Example of a Software Defined Radio system



MATLAB over LabVIEW

The choice was made to complete the program in MATLAB instead of LabVIEW. There are three factors that affected this decision: In MATLAB, there is

- Direct configuration of Xlinx FPGA
- More robust waveform modeling tools
- Shorter programming time for Software Defined Radio waveforms

MATLAB code

```
function [voltval, voltid] = voltrange(f,minimumR,maximumR)
% ii < length(f), needed to ensure loop is not infinite
ii = 1;
while f(ii)>=minimumR & f(ii) <= maximumR & ii < length(f);
    ii = ii + 1;
end;

voltval = f(ii);
voltid = ii;

if voltval >= minimumR & voltval <= maximumR
    fprintf('\n Voltage is in Range \n')
else
    fprintf('\n Voltage is out of Range\n')
end;

return;
```

Research Results

- Successful development of a code that acts as a function to analyze voltage read in a vector
- Code initializes the instrument and controller configured in the Instrument Control Toolbox
- Experience using LabVIEW

Future Research

- Complete the "RF Board Check" section of the program
- Ensure code uses the minimum amount of time needed for the test

The Research Alliance in Math and Science program is sponsored by the Mathematical, Information, and Computational Sciences Division, Office of Advanced Scientific Computing Research, U.S. Department of Energy. This work was performed at the Oak Ridge National Laboratory, which is managed by UT-Battelle, LLC under Contract No. De-AC05-00OR22725. This work has been authored by a contractor of the U.S. Government, accordingly, the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution , or allow others to do so, for U.S. Government purposes.

Special thanks to J.P. Jones, Jr. and Paul Ewing for being excellent mentors and giving me their expertise on my research. They have volunteered their time and efforts toward my project and I give them my utmost appreciation. Thank you also Debbie McCoy for giving me an opportunity to spend the summer furthering my career experience at Oak Ridge National Laboratory.

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