

A Cost-effective Solution for Photovoltaic Panels Performance Monitoring Using NI LabVIEW

By Laurent Mingo, P.Eng.
Project Leader & Systems Development
Blue System Integration Ltd.



Large photovoltaic array
Photo credit: Day4 Energy Ltd.

technology that improves the efficiency of a photovoltaic (PV) cell in producing electricity. Based on a modification of the manufacturing process, the resulting PV cells produce more electricity for a given panel areas, making them more cost effective in terms of produced power for a given panel size.



R&D photovoltaic array in Vancouver
Photo credit: Day4 Energy Ltd.

The MPPT first acts as a dc to dc power converter. Most importantly, it also constantly tunes the load so that a panel operates at maximum power. The elbow of the I-V curves marks the current-voltage conditions where power output is maximum. Temperature plays a significant role on how much power is produced, panels are more efficient at low temperature, and the role of the MPPT is equally critical in that regard.

Hardware

First, a MPPT model with serial communication capabilities was chosen. One MPPT being required per group of panels being monitored, a serial hub was also added into the system. This device allows communication with all addressable MPPT units. Since acting as dc to dc converter, the MPPT is able to return the produced power as well as several voltage and current key parameters which in turn can be captured by the data acquisition application. Second, a stand alone weather station was chosen, also equipped with a serial communication interface. Finally, panel temperature measurements were performed using RTD sensors connected to a NI Compact FieldPoint hardware platform (cFP-RTD-124 module). All systems were placed onto a LAN, either directly, in the case of the Compact FieldPoint, or through a serial-Ethernet converter device

The Goal

Characterizing the performance of a solar panel array in a research and development setting.

The Challenge

Integrating several types of instruments into a single system capable of acquiring measurements from all data sources placed on-line. Making the system database-ready for data analysis. Low-cost solution.

The Solution

Taking advantage of National Instruments (NI) LabVIEW's capability to acquire data from multiple, heterogeneous hardware platforms. Using NI Compact FieldPoint data acquisition hardware for scalability.

Introduction

Day4Energy Ltd., based in Burnaby, BC, has developed a proprietary

For research and development purposes, the company wanted to test the performance of prototypes panels under various meteorological conditions and installation types. In this context, the main parameters affecting the panels are the amount of sun it receives as well as its temperature. In terms of produced power, the PV system is equipped with a maximum power tracker (MPPT).

Solar Cell I-V Curve in Varying Sunlight

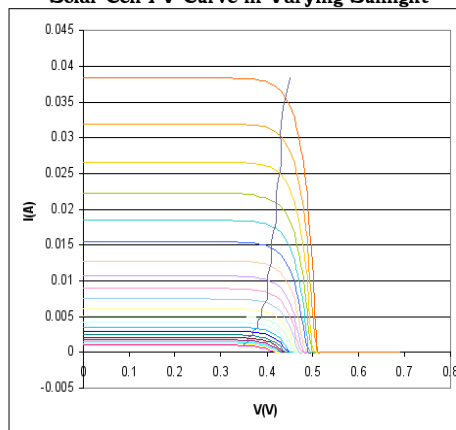


Figure credit: Wikipedia

for all MPPTs and for the weather station. From the data acquisition device's perspective, all instruments are now part of the same network and great distance can be run between measuring devices and the main acquisition system. Such a system can now run with either a PC-based application linked via LAN to a Compact FieldPoint controller like the NI cFP-1804, or run embedded with a NI cFP2xxx family controller running under LabVIEW-Real-Time.

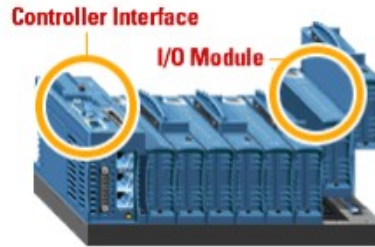
Software

The main data acquisition system was developed with NI-LabVIEW. This application underscores what has been one of the strengths of the LabVIEW development environment since its beginning more than 20 years ago: a seamless software-based integration of various types of measurement hardware into a single system.

Taking advantage of the serial communication interfaces of both MPPTs and weather station, the software application acquires data from all hardware platforms present on the LAN. In a similar fashion, using NI-FieldPoint native drivers, temperatures are acquired from the Compact FieldPoint modules. Finally, data are time stamped, formatted, and organized, prior to be saved to file.

Data management is an important part of any application. It is often neglected even though it sets the stage for how usable the data will effectively become. In this application, data quality indicators, or meta data, were added to the measurements when appropriate. While still using an ASCII file-based storage, transition towards a database solution should now be facilitated for expanding the data analysis capability of the system.

Expandability and Versatility



*Compact FieldPoint platform
Image credit: National Instruments*

Many options are available to upgrade the current system. Additional temperature sensors could be considered to better define the panel temperature over its entire area. Current and voltage probes could be added independently of the MPPT. A different model of MPPT could also be used. All These modifications can be accommodated. At the hardware level, the variety of modules available for the Compact FieldPoint platform is the main avenue for expanding functionality. A variety of voltage, current, and digital I/Os modules are available, as well as Ethernet expansion, should additional controllers be required. On the software side, LabVIEW flexibility to interface with many industrial protocols makes it an ideal choice for expanding systems functionality. Improving data management can also be achieved by linking this current system with a BSI database application that is being developed to organize data from multiple Day4's R&D remote sites, all equipped with solar arrays.

Conclusion

To facilitate the shift towards sustainable energy production away from today's predominant carbon emitting technologies, the production of electricity using photovoltaic cells is a

promising choice. Like demonstrated in this application note, BSI can help renewable energy and clean technology companies in achieving their goals. On the technical side, we have introduced yet one more example of a system using National Instruments hardware with LabVIEW, underscoring how powerful these combined solutions can be.

NI PXI-4130 Power SMU



Image credit: National Instruments

As of June 2008, it is also important to note that NI has just released a new PXI product, the NI PXI-4130, particularly well suited for solar panel characterization in a production environment. We are looking forward to use this new hardware in the future.

*For more information, contact
Laurent Mingo at Blue System
Integration Ltd.
laurent.m@bluesystem.ca
www.bluesystem.ca*

*Team:
Main architecture: L.Mingo, BSI;
Serial drivers, main system integration,
testing: O. Lessard Fontaine, BSI;*