Implementation of Smart Grid Using Lab View

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Abstract— Like the Personal Computer and smart phone, most disruptive ideas combine existing elements in a way that provides a dramatically better solution. The same phenomenon is true for the smart grid. Embedded reconfigurable instrumentation and control systems powered by National Instruments (NI) Laboratory Virtual Instrument Engineering Workbench (LabVIEW) software are merging with cloud-based networking, analytics, and other cutting-edge information technologies. The proliferation of smart networked embedded systems, widely distributed throughout the grid, will revolutionize the way electricity is produced, consumed, and distributed. Like the information technology (IT) revolution that drives it, the energy technology (ET) revolution will bring dramatic innovations that make energy cheaper, cleaner, and more abundant. By this presentation spectators can understand the technology development in the fields of energy.

Keywords: Lab view, Smart grid, Field-Programmable Gate Array, Ethernet Local Area Network

I. INTRODUCTION

Today, power systems are undergoing a dramatic change. An electrical grid receives power from a variety of sources and distributes that power to different consumers. To achieve maximum efficiency, the grid should operate in a smart manner. The power flowing in and out of the grid must be closely matched on a real-time, continuous basis. In many countries, it is a challenge for electric utilities to provide reliable, quality power due to equipment failures, power disturbances, and outages that result in service interruptions. Enhancing energy security and energy access, particularly in emerging economies with depleting energy resources, and generating power effectively and intelligently, which is equally important at the national level in India.

II. DESCRIPTION OF THE SOLUTION

The key to solving these challenges is accurately monitoring the grid to ensure uninterrupted power services to the consumer. Our proposal created a real-time smart grid system using Laboratory Virtual Instrument Engineering Workbench (LabVIEW) that integrates innovative, cost-effective technologies to help utility companies monitor their systems. Our proposal chose the National Instruments (NI) Compact Reconfigurable Input Output (RIO) because it is the ideal platform to meet the smart grid challenges. NI Compact RIO offers real-time, parallel processing, small size, and low cost for the final solution. The NI Compact RIO platform contains an onboard real-time processor, a reconfigurable Field-Programmable Gate Array (FPGA), and analog and digital I/O. Our proposal created a system where NI Compact RIO devices act as the primary data acquisition and processing system, a power supply, and a modem daughter board. The data acquisition, control, networking, and data logging algorithms are compiled on the real-time target through a user-configurable application. Our proposal developed the user-configurable application, called Station Master Configuration Tool (StatMAC), using NI LabVIEW graphical development software to perform the following configurations: Communication, Protocols configuration, Local data logging, Digital I/O, Analog input, Device settings. The smart grid supports multiple industry protocols, such as standard Modbus using remote terminal unit (RTU) mode, DLMS, DNP, and IEC 101. The smart grid can communicate using wired RS232/485, Ethernet Local Area Network (LAN), and Internet networks or wireless GSM/SMS, GPRS/FTP, and GSM/Data. As the electrical network expands, the need for additional digital and analog channels also increases. To meet future requirements, the system features expansion slots so the user can plug in NI Compact Series modules to expand the I/O channels. The same unit can monitor and control switchgears such as circuit breakers, transformers, capacitors, and batteries. Developing the first-of-its-kind smart mini grid (SMG) system in India, driven by state-of-the-art power electronics devices and controlled through ultra-fast digital technology based on NI Compact RIO hardware and NI LabVIEW system design software, which ensures a higher degree of flexibility, reliability, efficiency, and safety for the complete power system.

III. DATA FEEDING THROUGH LABVIEW COMPACT RIO

This document will describe some of the general usage of Compact RIO. Compact RIO paired with the NI LabView graphical development environment gives you the ability to create embedded control and monitoring systems with unparalleled productivity. Compact RIO is designed for applications in harsh environments and small places. Size, weight, and I/O channel density are critical design requirements in many such embedded applications. By taking advantage of the extreme performance and small size of FPGA devices, Compact RIO can deliver unprecedented control and acquisition capabilities in a compact, rugged package with extreme industrial certifications and ratings for operation in harsh industrial environments. Temperature ranges of -40 °C to 70 °C (-40 °F to 158 °F), 50 g shock...
rating, and a variety of international safety, electromagnetic compatibility (EMC), and environmental certifications and ratings are all available with Compact RIO.

A. Software Interface

First you need to make sure that you have all the software installed and that the hardware is working properly. You need LABVIEW installed with Compact RIO. LabVIEW is a graphical development environment with configuration-based tools and powerful programming capabilities for with professional user interfaces. The LabVIEW reconfigurable I/O (RIO) architecture makes FPGA technology easily accessible, so you can define your own control circuitry while reducing the complexity and costs associated with traditional custom hardware.

B. Compact RIO Requirements

RIO needs LabVIEW, LabVIEW Real Time Module, LabVIEW FPGA Module and LabVIEW NI Driver

IV. REAL WORLD USE

For optimal renewable energy usage, a LabVIEW program was created to monitor the following data: ambient temperature, wind speed, wind turbine rate of turn, bar pressure, input and output currents and voltages of the inverter, voltage of the Absorbent Glass Mat (AGM) batteries. This monitoring program will be further developed to incorporate additional sensor inputs and control outputs for the smart house subsystems powered by the Model Predictive Control (MPC) algorithms and functions.

Meteorological data are saved in table form and are used to calculate the characteristics such as Energy produced by the solar module in a year, day, or hour. Energy produced by the wind generator in a year, day, or hour. Battery performance and stress analysis under different loads and weather or time conditions. Predictive modeling of the house behavior.

The figure above illustrates the Front Panel of the LabVIEW program created for monitoring energy circulation in the smart house.

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V. BENEFITS

Improving Power Reliability and Quality. Minimizing the Need to Construct Back-up (Peak Load) Power Plants. Enhancing the capacity and efficiency of existing electric grid

Improving Resilience to Disruption and Being Self-Healing. Expanding Deployment of Renewable and Distributed Energy Sources

VI. APPLICATIONS

The Smart Micro Grid system can be used in the following areas: Industrial and commercial complexes such as shopping malls, hotels, and hospitals. Residential complexes such as apartments and townships. Educational institutions. Off-grid rural, per urban locations and Telecom base stations

VII. CONCLUSION

Once completely installed, the system transforms how the utilities view the smart grid by giving them increased observation capabilities, which accelerates the improvements in overall grid reliability. The smart grid unit developed using NI compact RIO is a reliable, low-cost solution with unique flexibility to fit into the solution automation system. Using NI hardware and software gave us a technical advantage and NI offered exceptional local support during the development process

REFERENCES

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