Using Embedded Computers to Manage Your Solar Power System

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Solar power is one of the hottest topics in the popular media today, particularly in light of the soaring prices of fossil fuels. As one of the so-called “renewable energies,” which also include wind, hydropower, biomass, geo-thermal, and hydrogen, the solar power market size is expected to reach upwards of 74 billion USD by the year 2017 (source: Clean Edge, 2008).

In some countries, the cost of implementing solar power solutions has been alleviated somewhat by generous government subsidies. Germany and Japan, for example, were among the first countries to provide individuals and companies with incentives for adopting solar power. These policies led to a marked increase in demand for solar power equipment, providing a major boost to the solar power industry as a whole. In recent years, however, some countries have begun to reduce their solar power subsidies. For example, Germany has recently passed a bill to decrease solar subsidies by 5-6.5% in 2008, with an annual reduction rate of 8-10% from 2009 to 2011. However, the decrease in subsidies is still lower than projected growth in overall market demand. Based on a study by Deutsche Bank, the solar power industry is expected to grow at a rate of 23-27% over the next three years.

Released on September 4, 2008

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Solar Energy and Embedded Computers

Solar energy technologies are designed to use the sun's energy to heat homes, provide lighting, create hot water, generate electricity, and even produce air conditioning for homes, businesses, and industrial applications. The basic aspects of a solar energy system include components (such as photovoltaic modules, solar cells, and inverters), integration, and installation. Computers also play an essential role in solar power systems, particularly when it comes to maximizing energy efficiency.

Embedded computers are ideal for use with intelligent solar management systems. Important features include:

1. Compact size: Compared with traditional industrial PCs, embedded computers are compact enough to fit in small cabinets.
2. Robust design: Embedded computers are fan-less, cable-less, and instead of using a hard disc, they use CompactFlash cards instead. This kind of rugged design helps ensure that the entire system will operate reliably 24 hours a day, 7 days a week.
3. Low power consumption and pre-built OS: Embedded computers are designed to be used with specific applications. In general, an embedded computer executes only 1 or 2 functions, and the pre-built operating system helps engineers develop specific applications based on the computing platform. With their compact size and all-in-one feature, embedded computers consume less power compared with traditional industrial PCs.
4. Fit for harsh environments: The robust design of embedded computers makes it possible to use them in hazardous environments, such as deserts and rain forests.

A typical solar power system is easy to describe. When the sun shines on the solar panels, the solar cells produce a steady stream of electrons in the form of direct current (DC) electricity. When sent to the inverter, the electron stream is

converted into alternating current (AC) electricity. The electricity created by the solar photovoltaic system is then combined with the electricity supplied by the local utility company, with the combination routed to the buildings and/or communities.

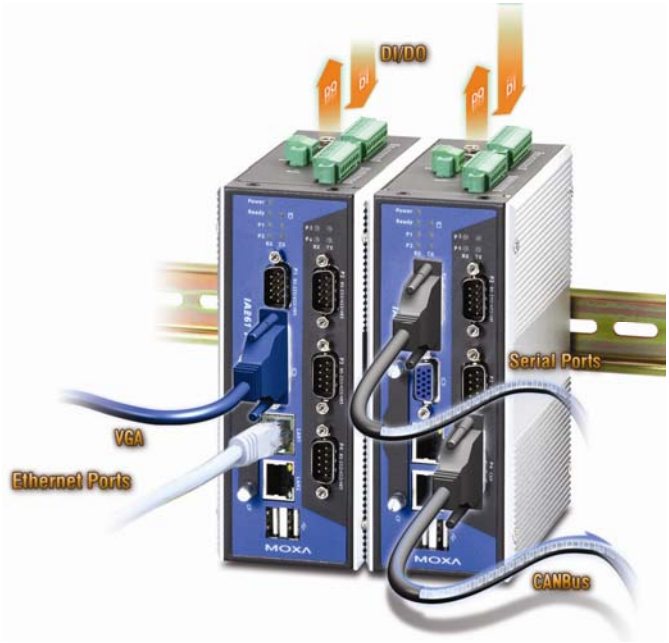
In recent years, people have also begun adding intelligent management systems to their solar power systems to monitor the efficiency of the system. For larger systems, it is also possible to connect the management system to a central control center for easier real-time tracking and to integrate data from several solar power systems. Implementing a web-based interface makes it easy for users to check how much energy the system is saving, and to provide ready access to the billing service.

Moxa's Embedded Controller

Users have had good results using Moxa's embedded computers as the core of their control system. The control system uses a distributed embedded controller to read data from several sources, including the inverter, electric meter, and re-chargers. Data is retrieved through the serial ports, after which it is redirected through the LAN or wireless connection to whichever hosts have been configured to receive it. What makes Moxa's embedded solutions ideal for use with solar power control systems is the variety of communication connection types that are supported:

1. Serial Communication Interface: RS-232/422/485
   Lower level devices often need to communicate with the front-end controller using serial transmission. Moxa's proprietary 3-in-1 UART supports RS-232/422/485 interfaces and non-standard baudrates.
2. Universal Serial Bus (USB)
   Provides an additional expansion option for adding storage devices and/or special purpose USB interface devices. Keep in mind that users may need to install a USB driver for their device.

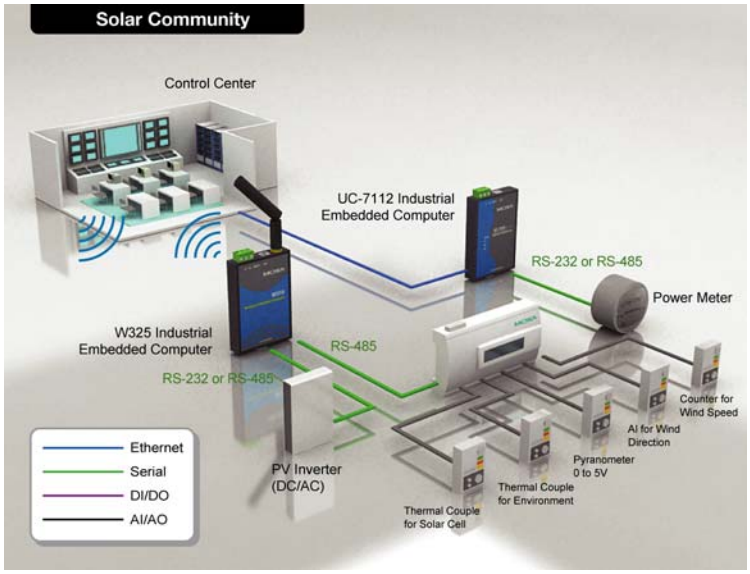
3. Network: Ethernet, Control Area Network
   Often used with industrial applications to receive or send data.
4. Discrete I/O: General purpose input/output (GPIO)
   Programmable I/Os for controlling I/O devices. Users can configure the I/O mode for their particular application.
5. Analog-to-Digital/Digital-to-Analog (ADC/DAC)
   Used for controlling AI/AO and DI/DO devices.
6. Wireless Interface: WiFi, GSM, GPRS, CDMA
   Used for receiving or sending data through the wireless infrastructure. Often used for environmental monitoring applications in remote areas that do not have cabling.



Examples of Solar Power Applications

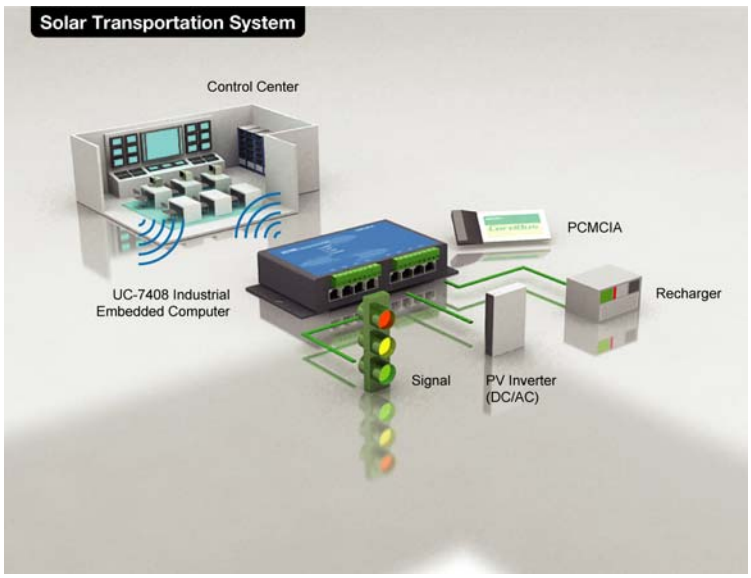
Application 1: Solar Community

Solar energy communities rely primarily on solar power for their energy needs, and consequently it is important that such communities set up stable and reliable remote monitoring systems. Moxa's W325 and UC-7112 embedded computers, for example, are ideal solutions for setting up the entire system. The W325 and UC-7112 can be used as front-end communication computers that connect to the PV inverter, AI and counter input module, and power meter. They can also be used for remote monitoring, data acquisition, data logging, and protocol conversion.



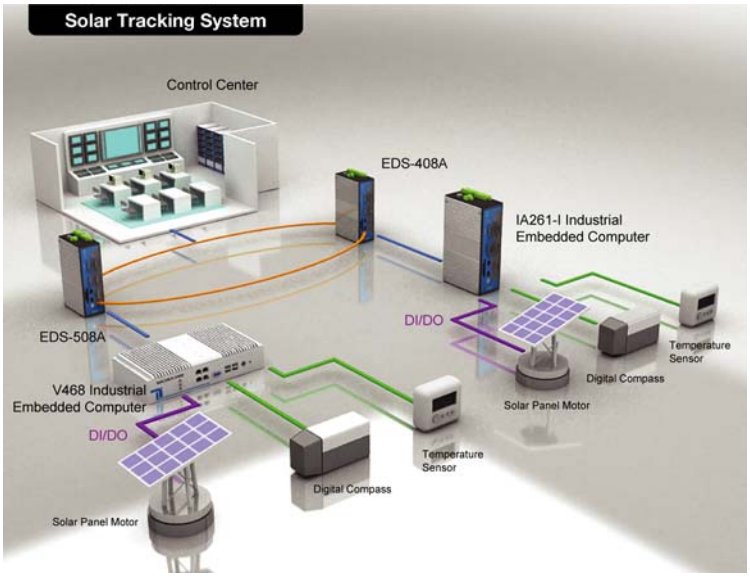
Application 2: Solar Transportation System

Solar power can be used to operate traffic signals, roadside displays, and various peripheral transportation devices. For these types of applications, embedded computers can be used to control, manage, and remotely monitor not only the traffic devices, but also the equipment that makes up the solar power system. Moxa's UC-7408 embedded computer, which features 8 serial ports and a PCMCIA card for wireless transmission, is a good choice for a variety of transportation systems.



Application 3: Solar Tracking System

Solar power plants and other sophisticated solar power solutions use solar tracking systems to maximize the amount of solar energy that can be absorbed from the Sun's rays. In this case, the embedded computer serves as the central controller for mapping and tracking the Sun. Moxa's x86-based V468 and RISC-based IA261-I embedded computers are a good choice for controlling a solar tracking system, and for sending data back and forth between the tracker and central control center.



NOTE: Moxa provides a rich selection of embedded computers for solar energy applications. For details, check our website at www.moxa.com, or contact the author, Ella Liao, at sys.support@moxa.com.