Industrial Data Xchange
The Industrial Data Communications Experts

CASE STUDY: Renewable Energy Monitoring Solutions

Remotely optimise and manage the performance of complex renewable energy systems

Solution: Nexus IO, Nexus IIoT

Industry: All industries

Benefits:

- ✓ Simple and economical
- ✓ Suitable for all industries
- ✓ Open and extendable
- ✓ High energy saving

Technology used:

- ✓ Nexus IO
- ✓ Nexus IIoT

Nexus is powered by IDX and its modular design of both hardware and software allows for extremely flexible monitoring of your data.

Nexus through combining hardware and software enables real-time data exchange of any, but mainly automation, building and industrial, data along with data logging into the Nexus Data Historian as well as full Cloud integration via MQTT and OPC UA.

Intelligent Energy Management for Industrial Enterprises

Investment in renewable energy assets such as solar farms, wind turbines, and hydroelectric generators are on an exponential growth curve, especially within the Sub-Saharan African region supplementing the use of backup-power diesel generators.

This is because businesses and residences are impacted by the shortcomings and variability in traditional coal, gas and nuclear power supply systems. Generation capacity is either completely absent or only partially available for restricted periods of the day.

Commercial, industrial and residential users therefore require the ability to establish remote connectivity of these systems and to be able to leverage these connections for system control and optimisation - from anywhere and at any time.

IDX is well-positioned to offer an industrial grade hardware-to-user interface solution to address the various complex data requirements of these systems. Within this case study, we will explore some of the challenges faced within these systems and how IDX designed and implemented solutions to overcome these.

There are two recent cases where parts of this solution have been adopted and implemented for remote monitoring and control, including a hydroelectric generation plant and a large solar farm within Sub Saharan Africa.

Hydroelectric power generation plant

The challenges

Renewable energy systems typically have a very high up-front capital investment, stakeholders must maximise system output to ensure fast return on investment or profitability from the sale of power for commercial utility providers.

There is a vital need to remotely optimise the performance of these complex systems, fine-tune and dynamically adjust key system parameters, as well as trend, log, and visualise system KPI data. The Engineering control and monitoring of renewable energy systems is a dynamic process that often requires remote and instantaneous fine-tuning.

The biggest challenge faced, is with a vast number of vendors within these industries providing renewable energy core components, there is often a complex system data integration challenge and constant incompatibility scenarios between system components, both software and hardware related.

The other challenge faced is that renewable energy sources often have an acute power supply limitation, and thus with changing consumer loads, the system requires the ability to instantaneously shed excess load when supply is exceeded to prevent system instability and failure.

Solar generation farm

The solutions

The solution can be split into three sections, based on the challenges and requirements:

1. Integration of disparate systems within a renewable energy system
2. Data logging, remote visualisation, reporting, alerting, and system configuration adjustments
3. The ability to dynamically control power consumers to ensure sustainable and optimal system performance

Let us go through these in some detail…

Solution 1: Integration of disparate systems within a renewable energy system

Renewable energy systems are built up of many components and parts that need to work together effectively. Very often the parts of these systems communicate through a digital communication channel, and even more often these communication channels will be incompatible between devices and components from different vendors.

For example, component A may support protocol X and component B may support protocol Y, to get A to effectively work with B you will need a protocol translator that can speak both X and Y and be able to share data effectively between the two components.

IDX has developed a software solution to facilitate the integration of these various protocols and components called *Nexus IO*. *Nexus IO* has an integrated core data exchange hub that allows the reliable and efficient transfer of data and associated parameters between various implemented interfaces. Conversion between various Ethernet/Ethernet; Ethernet/Serial; Serial/Serial and wireless-based communication standards are commonly handled by *Nexus IO* along with associated industrialised embedded PCs.

Solution 2: Data logging, remote visualisation, reporting, alerting, and system configuration adjustments

Pulling data out of your systems, whether remote or local has countless uses and advantages. There are some key implemented functional areas apart from standard operations that needed to be considered including:

- The solution should have the ability to log data locally if the devices' data connection to a cloud service/server fails, then back full captured data once the data connection is re-established. Especially where systems are installed in remote parts of the African continent with intermittent internet connectivity.

- The solution must implement an alerting system, capable of prompting information to users through various channels (Email, SMS, mobile device pop up) when a key value's change or pass through a predefined threshold.
- Users must be able to change the configuration of the device sitting on the site (that may have very limited and remote access) remotely. Thus users would not need to travel to the site to make changes to the parameters of the device.
- The device should have the capability of transferring data to either a local server (keep information internally) or a remote server (commercial cloud solutions such as AWS and Azure).

With these in mind, IDX developed a solution which we named *Nexus IIoT*. The *Nexus IIoT* solution consists of a system specified embedded PC, *Nexus IIoT* software running on the device facilitates communication with the system components, runs a basic logic engine for cyclic device action and control, publishes and subscribes data between the endpoint server (Cloud or local server-based) and system components. The hardware utilised supports various interfaces to link to components on the site (serial, ethernet, and CAN-based), as well as a local SQL-based database for logging immediate data that cannot be published for whatsoever reason.

Once the data is shared with the endpoint server users can take advantage of intuitive dashboards for data visualisation, reporting, alarm handling, and system configuration, and optimisation. Users can then leverage their system data to make optimisation and control decisions.

Solution 3: The ability to dynamically control power consumers to ensure stable and optimal system performance

The *Nexus IIoT* software mentioned in the previous solution description is further developed to integrate directly into site power components, power meters, and electronics, that allowed for the implementation of a logic engine to analyse and provide control based on the following points:

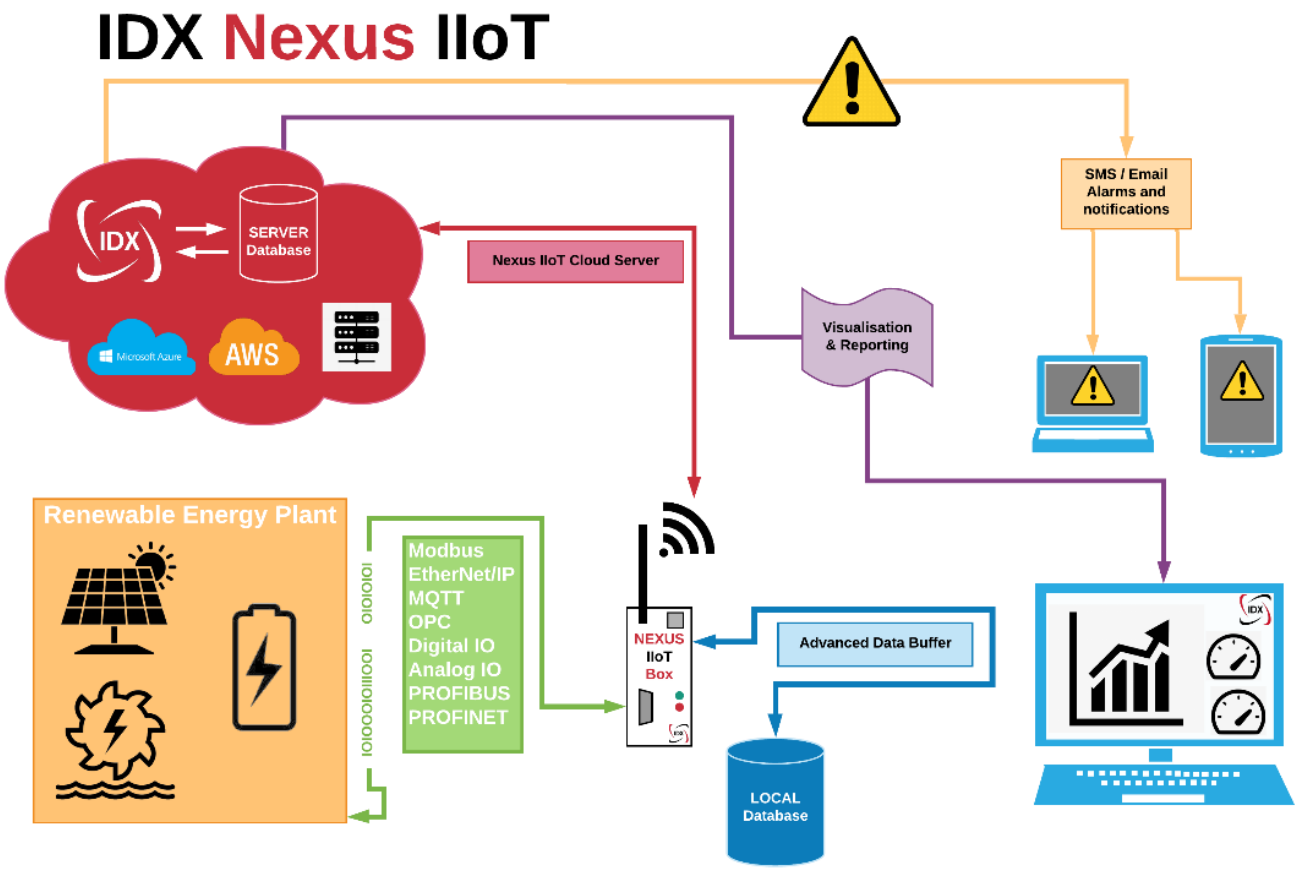
- Total Power Input (Generation)
- Total Power Output (Consumers)
- Subcomponent consumption, state, and user-provided priority classification
- Utility state (Is there grid power available)

Through the smart implementation of a specified priority table (Remove low priority loads first), the system can automatically toggle switchgear to "shed" loads if demand exceeds generation/supply and the state of utility is low, or energy optimisation is enabled. Alternatively, if there is excess generation/supply, the system can add on excess load such as heating and cooling systems to utilise maximum supply and optimise system output and performance.

With this monitoring and active control, system stability is dramatically improved and output optimisation of the system generation is maximised.

Monitoring and control from points of generation: control and consumption

Nexus IIoT system architecture



Nexus IIOT system architecture

Conclusion

Through the implementation of the *Nexus IO* solution, your power generation application is enhanced to allow for the integration and communication flow between disparate systems and components within your installation. This allows designers to implement the best and most cost-effective technologies independent of vendors and protocols supported.

Utilising the *Nexus IIoT* solution in your power generation project will give users the ability to remotely access and control their systems from anywhere in the world, to securely log and trend critical system performance data, and even implement machine learning algorithms to detect anomalies, potential system failures (preventative maintenance) and ensure the optimum utilisation of the generation assets.

Have a unique communication or data related application not discussed here? Please reach out to one of our Industrial IT Engineers.

About Industrial Data Xchange:

Industrial Data Xchange (IDX) provides industrial IT & IIoT solutions and related services to primary and manufacturing industries. Our services include building automation, custom development, custom & legacy integration, data migration, and industrial IT consulting. IDX also provides services to help keep your control networks, especially PROFIBUS & PROFINET, running in tip-top shape. Our industrial network audits will proactively assess the health of your control networks and our industrial network emergency callouts to get you up and running when a breakdown occurs. Our IDX Academy offers internationally certified PROFIBUS & PROFINET training as well as ASi, CANbus, Modbus protocol training, and more.

Contact us for all of your connectivity challenges:
Address: 1 Weaver Street, Fourways, Johannesburg, Gauteng, South Africa
Phone: +27 11 548 9960 | Email: info@idx.co.za | Website: www.idx.co.za

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