Deploying IIoT Sensors and Networks in Remote Locations

IIoT systems add value within a plant, but they are also a natural fit for data gathering in the field.

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Smart sensor and device installations are flourishing everywhere, forming the basic building blocks of any internet of things (IoT) initiative. Applying IoT capabilities can be a useful way to monitor and even initiate control for consumer applications like home temperature, lighting, and sprinkler controls. When smart devices are made tougher and connected securely over the internet, they can function as key components in the industrial IoT (IIoT).

Manufacturing and processing companies are rapidly implementing IIoT projects because of expected benefits as proven by other firms in the same sector. Wireless IIoTcapable instruments are far easier to install than conventional wired devices and make it convenient to monitor machine conditions, process equipment, and work areas to identify issues before they become more significant problems.

Thinking outside the walls of a home or factory, the IIoT is ready to help digitalize and gather data from even more expansive applications such as environmental conditions. A prime example is using the IIoT to constantly and easily measure the surface water quality in rivers and lakes.

This article will discuss how today's digital ecosystems have progressed to enable a complete solution of sensors, communications, software, analytics, and visualization empowering users to readily monitor and be alerted about changing environmental conditions.

Water Matters

Monitoring the condition of the world's surface water is a relatable and worthy endeavor. We all need and use water every day and are aware personally or through news reports of the many ways worldwide that water resources have been polluted. For instance, a tiny amount of oil can contaminate great quantities of water, and there are many other pollutants such as plastics, chemicals, and bacteria which are harmful to natural water conditions.

Some water pollution can be traced to point sources, such as farms or factories with improperly treated discharges. Other types of pollution are much harder to trace and diffuse, originating from airborne fumes and gasses and returned to surface water during rainfall.

The consequences of polluted water are many. Dissolved oxygen must exist at a certain minimum level to support healthy marine life, while too much oxygen can impair good bacteria that would otherwise decompose wastes. Obviously, chemicals or other materials present in polluted water can



Figure 1: Traditional methods for monitoring surface water require researcher travel to challenging sites, which is expensive and leads to incomplete data





Figure 2: Water sensor technologies and transmitters for conductivity, DO, and pH make it possible for continuous measurement even in difficult locations.

be toxic and cause health problems for humans or wildlife that drink or even just come into contact with the water. Some chemicals are nutrients that may promote algae growth, in the worst case leading to harmful algal blooms (HABs) which can rapidly deplete oxygen in the water and in turn cause sudden fish kills.

Good monitoring practices can identify these and other problems early so they can be addressed quickly before more serious conditions develop.

What Can Be Done?

A first step in solving any problem is gathering data. Measuring water conditions are the only way to understand not only the instantaneous status, but also the historical and trending conditions. Recording, viewing, and analyzing this data is also the only way to determine if corrective action is having the desired effect.

The remote and outdoor nature for surface water locations introduces many measurement challenges (Figure 1). In years past, researchers would periodically travel to these bodies of water and take samples for later analysis, a time-consuming and expensive method that can introduce errors and lead to gaps in the data.

Today, the IIoT is enabling many types of intelligent measuring technology to be easily deployed. This is

particularly the case for water analytical situations, where the key parameters of interest are:

- Conductivity
- Dissolved oxygen (DO)
- ∎ pH
- Temperature

High conductivity can signal pollution by chemicals or metals. The critical role of DO has already been discussed. Measurement of the water pH indicates if the water is too acidic, another condition that can threaten marine life. Finally, high water temperature is not a pollutant, but it can be dangerous to the health of marine life, and in conjunction with other conditions can lead to increased chances for an algal bloom.

Combined, these four measurements provide a comprehensive profile of water health. Therefore, installing an effective measuring system for these parameters is fundamental to efforts for protecting the environment.

Measurement Methods

Many of the sensor technologies used to measure water quality are well-established methods, although they must be configured for the outdoor environment (Figure 2).

Conductivity sensors measure how easily the water conducts electrical current, with higher conductivity indicating a

high number of ions due to dissolved salts or inorganic materials. Water pollution can be a reason for unexpectedly high conductivity.

Both optical and amperometric dissolved oxygen sensors are available today for accurate and reliable oxygen measurement with minimal maintenance.

Natural bodies of water usually have a pH value between 6.5 and 8.5. Most pH sensors use a glass electrode and can measure over a wider range than this. An additional feature of many pH and conductivity sensors is incorporation of a Pt1000 RTD sensor to provide a temperature reading.

For surface water monitoring, it is important to select sensors that resist extremes of corrosion, moisture, soiling, and fouling. They must be easily installed, serviced and calibrated. The most advanced sensors, such as Endress+Hauser's analytical sensors with Memosens technology, maintain their factory calibration information on-board and communicate it to the transmitter when connected, simplifying maintenance.

These sensors use digital technology that allows them to easily connect to a universal digital transmitter. A digital transmitter makes data easily available to remote monitoring systems.

Bringing it all Together

Instead of buying sensors and devices from various vendors and trying to make them work together, a better approach is to obtain all sensors and the associated multi-channel transmitter as a coordinated package from a single source. In fact, packaging a suite of traditional sensors with modern instrumentation is the key to quickly creating an IIoT-capable system in a cost-effective manner (Figure 3).

The most capable instrumentation kits will use sensors with intelligent connectivity to the transmitter, simplifying installation, operation, and maintenance because they supply both calibration information and measured values. Power must be connected to the transmitter, but it is usually impractical to run any type of wired phone or network connection to a water measurement system. Therefore, it is important for these systems to incorporate a cellular device. This enables the system to act as an IIoT device with connectivity to the cloud, making the transmitter an information gateway supplying sensor data.

Transmitting raw data is just the beginning. A comprehensive system like the Endress+Hauser Netilion Smart System for Surface Water includes not only the necessary hardware, but connectivity to an associated IIoT cloud. The most basic functionality lets users visualize all data values using a compatible mobile app. Other advanced features useful for surface water monitoring include:

- Geographical-oriented overviews, location indications and device information
- Data history of measured values with graphical views
- Notification of limit and alarm events and acknowledgements, with overview
- Display of NAMUR NE 107 status messages



Figure 3: The Endress+Hauser Netilion Smart System for Surface Water includes the key sensors, transmitter and accessories needed to deploy a complete surface water monitoring system, and connect it to the Netilion IIoT Cloud, all in one box.

It is possible for users to assemble and configure the sensor, transmitter, communication, cloud and monitoring elements. However, using a pre-configured system tailored for surface water monitoring is likely the most cost-effective, convenient, and reliable way for end users to monitor the measuring points from anywhere and at any time.

IIoT Improves Fish Farming

Aquaculture, or fish farming, is an important industry worldwide. Obviously, water quality is an important factor for this activity at all stages of raising fish from fingerlings up to harvesting size.

Water quality concerns for aquaculture are quite similar to those for surface water monitoring, with DO measurement in particular a prime concern. While general water monitoring applications measure conductivity, aquaculture end users need to know the amount of ammonium in the water. In addition to pH, these aquaculture facilities are also concerned with the level of nitrates in the water.

Fish will thrive best when the DO level is proper for their health. Many aquaculture operations incorporate active aeration, so not only are DO measurements monitored, but they can be used to optimize the aeration levels. Ammonium concentrations vary based on fish feeding and excreting, and on water treatment cleaning performance. Continuous measurement is important to ensure ammonium is kept at safe levels, and to enable a proactive response if it is trending the wrong way.

Nitrate concentrations can negatively impact the health of farmed fish, but another consequence is that high nitrate concentration in the farming plant discharge can have a negative environmental impact. This is because nitrates promote the growth of algae, which as discussed earlier can lead to anaerobic zones and other problems.

Installing IIoT systems using water measurement technologies, linked to the cloud and mobile devices, is a

positive step to actively managing and optimizing aquaculture. End users can understand the health of their operations, make changes to improve performance, and be alerted with remote alarm notifications before potential issues develop into major problems.

Conclusion

Surface water resources are vulnerable to many types of physical, chemical and biological pollution that can harm people, animals and plants. Manual data gathering in isolated locations is a good start to improving water quality, but unlikely to provide a broader, real-time solution.

Improved and automated data gathering and analysis are key to understanding water quality and identifying the most impactful pollution sources. Fortunately, IIoT instruments and methods are available to establish a comprehensive measurement and monitoring program. This is a necessary first step in efforts to protect water resources.

About the Author



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