



Industrial IoT Gateway for Intelligent Manufacturing

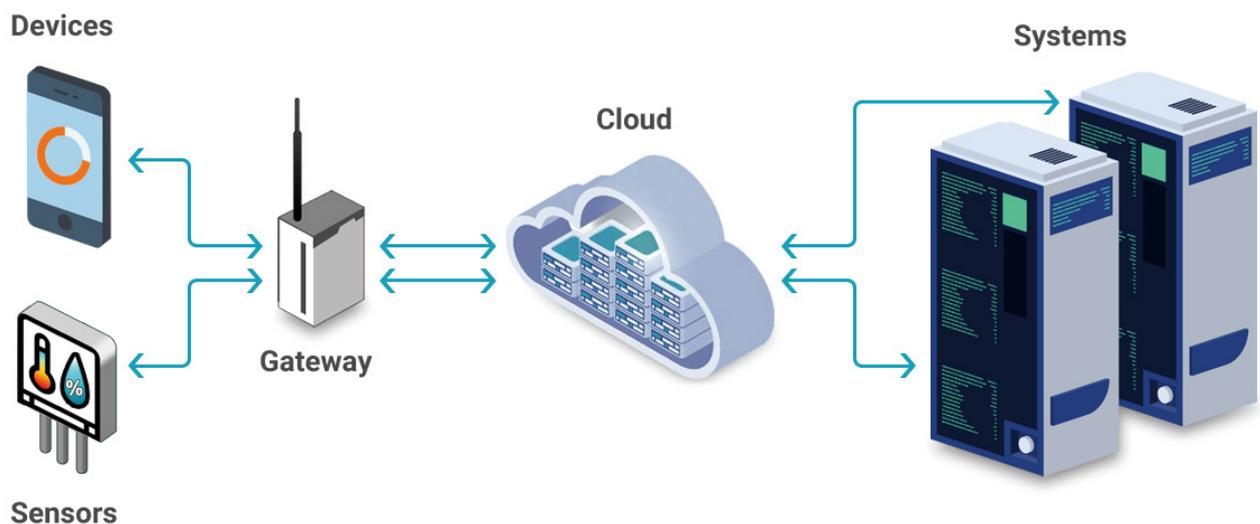
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The earliest Internet of Things (IoT) concept appeared in a speech in 1985 by Peter T. Lewis, he said “The Internet of Things, or IoT, is the integration of people, processes and technology with connectable devices and sensors to enable remote monitoring, status, manipulation and evaluation of trends of such devices.”

The utilization of IoT applications is all around us, from something as small as vending machines to retail goods distribution. The simple stock count and report IoT loop ensure stock availability for purchase. The simple data acquisition loop has been proven effective time and time again for retail applications with IoT implementation.



Collecting real-time data, an IoT gateway is positioned between edge devices/ sensors and cloud applications/ systems. An industrial IoT gateway is no different and is implemented to acquire real-time operational statuses via industrial-specific data acquisition channels and analytically present valuable operation insights to improve efficiency, and in the process, the data may be utilized to predict machine failures. Although the practical application of the industrial IoT is extremely diversified, however, the core essential elements remain the same. Of which, an industrial IoT gateway plays the role as the data gatekeeper between operational technology (OT) to information technology (IT). The industrial IoT gateway acquires data, processes local data, translates data/ communication protocols, secures data for transport, sends translated data to the cloud, and also allows data to flow back to OT devices for probable actions. To execute functions, an industrial IoT gateway must have the following capabilities: built-in industrial-specific data acquisition channels, edge computing, data wrangling, data encryption, pre-certified by wireless carriers, support for cloud communications and the ability to survive in harsh/ rugged industrial environments.

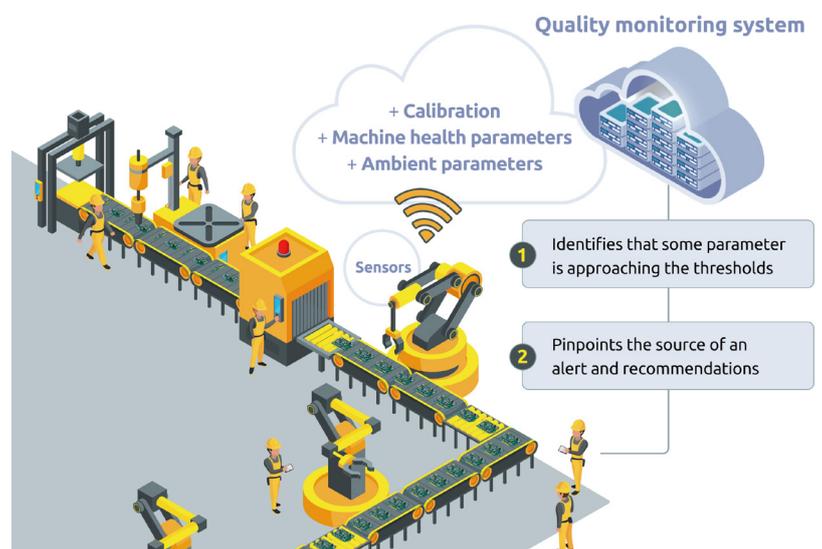
Estimated to expand to 75 billion IoT devices by the year 2025, establishing an industrial IoT network can benefit factory manufacturing operations by providing analytic insight data. As the world is digitizing in every aspect, manufacturing processes are no different. Driven by customer and volume demands while trying to reduce costs, manufacturers need to find ways to stay ahead of the competition. The industrial IoT plays an important role in digitizing manufacturing and by deploying industrial IoT gateways to maintain a constant communication pathway between your OT and IT to increase workers' safety, improve quality, maximize production rate, avoid unnecessary machine downtime and lift overall efficiencies.

Industrial IoT for Predictive Maintenance in Intelligent Manufacturing

The diverse application of an industrial IoT system in intelligent manufacturing has many benefits but in this article, we are going to focus on “predictive maintenance (PdM)” of floor OT machinery. Deriving from predictive maintenance, you will see other perks such as minimizing downtime, better energy management, operating efficiencies and overall operating cost savings.

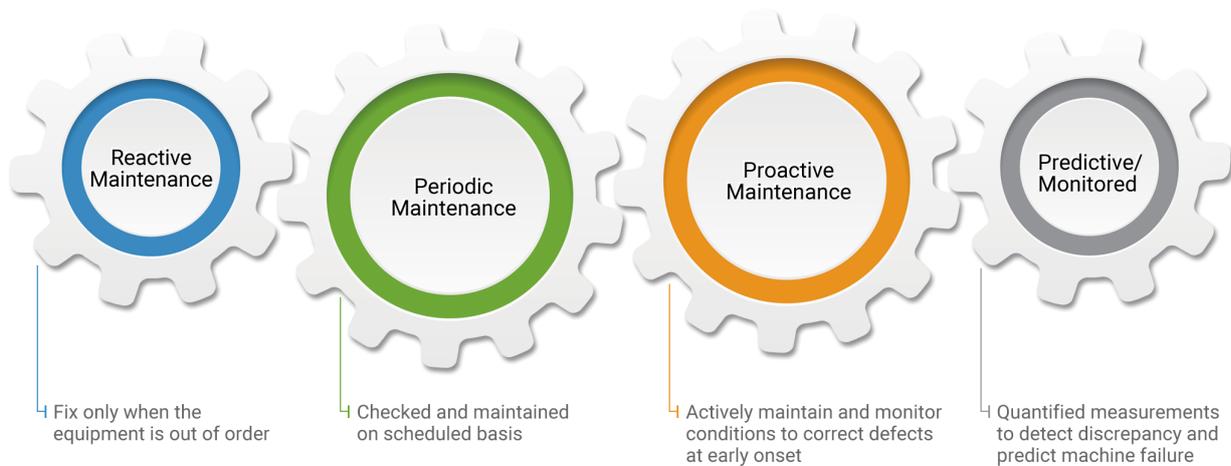
Before we get to PdM, we will need to address one of the main concerns in transforming a factory to an intelligent factory, the existing legacy machinery. Legacy machinery are “older” machines that were not created with IoT digitization in mind, hence the lack of connectivity or wireless communication capability. There are now smart industrial grade sensors and dedicated kits that can be deployed to attain quantifiable data from legacy machinery; or there are industrial gateways that feature both digital and analog connectivity to communicate with legacy devices, turning them into a part of your industrial IoT system. Now that all machines on the factory floor are on the same page in terms of IoT connectivity, let’s move onto PdM in intelligent manufacturing.

Traditionally, factories schedule their maintenance tasks as this allows them to plan their downtime and minimize the factory’s loss of productivity. The scheduled maintenance is the most common means of avoiding machine failure and factory operation downtime, it is based on a predetermined interval of workload sustained by the machine, it assumes a higher failure probability with repeated usage or time (age). However,



research from ARC Advisory Group has shown that repeated usage and the age of machinery only contribute to approximately 18% cause of failures for industrial assets; while the other 82% arise from random failure instances. Apart from the obvious productivity loss and repair cost, the random failures may also result in a series of butterfly effect in the factory such as direct/ indirect associated machine failures, safety risk/ concerns and excess salary payment from overtime work ^[1].

An effective method to reduce the 82% random failure instances is through the utilization of PdM by implementing an industrial IoT system. By deploying industrial-grade sensors, it can monitor the operation status of critical components such as operating temperature, rotor vibration detection, revs per minute against predetermined safe range thresholds. The data are collected, computed and sent using industrial IoT gateways to the cloud for data analytics. The processed data are then presented on a human-machine interface (HMI) where the insight data can improve the overall efficiency of the factory but more importantly, they also show signs of wear and tear of floor machinery; which may be a telltale sign that necessary maintenance or repair is needed and can help you avoid bigger problems in the near future.



Schedule (reactive) vs predictive (proactive) maintenance ^[4]

Statistics show that by implementing a predictive maintenance system, it can reduce production losses by more than 20 percent, increase asset availability by 5 to 15 percent and reduce maintenance costs by 18 to 25 percent ^{[1] [2]}.

Overall, according to management consulting firm, McKinsey & Company, a PdM system can reduce the costs of ownership of factory equipment by up to 40%, while reducing downtime by 30 to 50% ^[3]. No wonder manufacturers are embracing industrial IoT-enabled predictive maintenance as a means of transforming their businesses.

To incorporate an industrial IoT system to detect the finest discrepancies and predict possible machine failures in a manufacturing factory, the industrial IoT system must be able to monitor

and collect floor machine sensor data (data acquisition) > process and digest the collected data > analytically filter and categorize the data > based on cloud application data analysis, provide practical and actionable insight data. You can set up sensors to pick up everything and anything quantifiable. This may include rotor noise levels, machine vision lighting, floor machinery operating temperatures, factory OT systems such as conveyor belt system, electricity, security, etc. The combination and exchange of data will generate useful PdM statistics that may help you detect the tiniest changes that you may otherwise overlook, which can result in bigger issues later down the road. Essentially, the more accurate, efficient and capable your industrial IoT gateway is, the better you can understand your factory machine statuses to minimize downtime and loss of productivity situations.

Essential Elements of an Industrial IoT Gateway

Operating in harsh environments

- ▶ Processor works from **-40°C to +105°C**
- ▶ System specification: **-25°C~70°C**



Fits into confined spaces

- ▶ Compact dimensions
- ▶ Metal DIN-rail clip

Designed for various power sources

- ▶ Work with the existing one
- ▶ Also powered by PoE PSE



Minimum maintenance

- ▶ Fanless
- ▶ Cable free



Survival in harsh environments is almost a given quality for industrial IoT gateways as they are often placed close to sensors that may detect extreme conditions which means they are also exposed to similar conditions 24/7. Industrial IoT gateways need to have a wide operating temperature that ranges from -25°C up to 70°C or so while the processor can withstand an even wider temperature range, such as from -40°C to +105°C.

Wide range industrial power acceptability plays an important role in the industrial IoT gateways' deploy-ability as more than often, the hard-to-reach locations have limited electrical distribution networks for power points. Hence the ability to accept wide range power input or other forms of power (such as PoE) can make deployment that much more convenient and deploy-able.

Real-time data acquisition is fundamental for industrial IoT gateways. With different data acquisition channels such as digital/ analog, Ethernet (Modbus, MQTT, TCP, etc.), serial connections, various data sources can be acquired from sensors or systems. Traditional OT

systems transmit a steady flow of data that is comprehensible between controllers (PLC, RTU, SCADA, etc.) to sustain operations. In an industrial IoT network environment, the OT systems send a large amount of data directly to IT cloud systems for analysis.

Data transmission between OT & IT through wireless connectivity

This data transmission between OT and IT is vital because the IT system's analytic data have a "cause and effect" action that it directly correlates to the optimization of field site OT systems. And how do OT data from field sites acquired by the industrial IoT gateway get to IT systems?

Data connectivity of course, but it's ideal to have the connection field-tested and pre-certified so when deployed outside the testing ground, the connection is viable (4G/ LTE reception, WiFi signal compatibility, etc.).

Data storage

But what happens when the network connection or the cloud service is down? The industrial IoT gateway should also have the ability to store data. The data can be temporarily stored in the industrial IoT gateway and the upload process may resume once the connection is restored. The ability to store data also reduces the chances of data loss and excess data transfer.

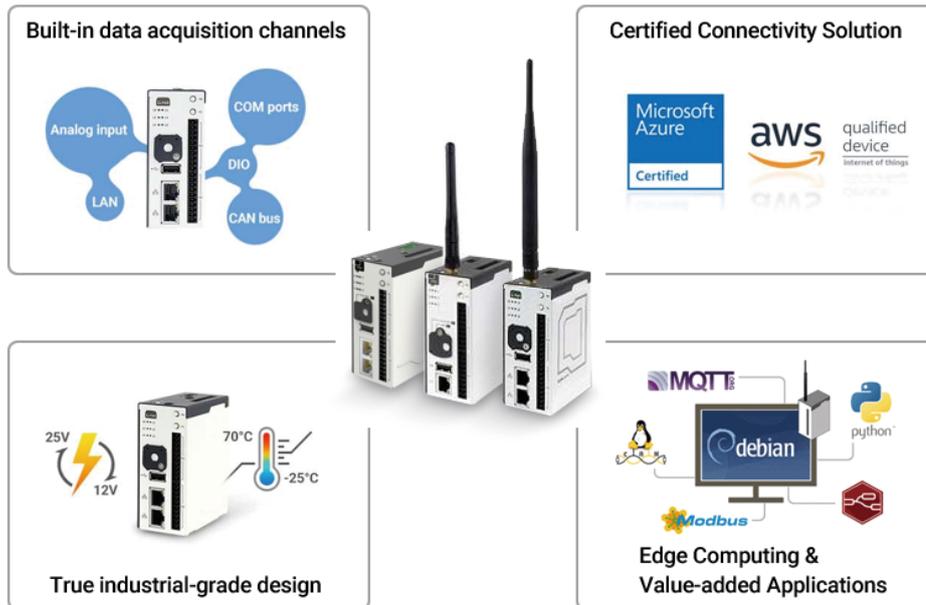
Computing at the edge

Imagine a manufacturing factory with air, water, electrical, security, etc., thousands of sensors and over hundreds of OT systems, you will be looking at a lot of OT device data. To have the ability to filter unnecessary or "no-need to send data", it will speed up and reduce transmission costs. So how are data classified as unnecessary or "no-need to send data"? This is where a next-generation industrial IoT gateway's ability to compute at the edge comes in. The onsite processed data offers immediate action/ reaction to on-site events and because this data is retained, it reduces the amount of raw data sent.

Data encryption

Once the need-to-be send data has been determined, the encryption process begins. Here, the main advantage of encryption is obvious as wirelessly transmitted business information data are prone to be hijacked; but once the data is encrypted, it is protected from direct hijack access and reduces security risks. Finally, the encrypted main data reaches the cloud application for analytics, the mass data can be organized and extracted, then be presented on a dashboard, a key HMI that displays your sensors/ OT systems' reading and statuses offering insights that allow you to manage and tweak your factory for efficiency or PdM.

Neosys IGT Series Industrial IoT Gateway for Predictive Maintenance



The Neosys IGT series is a true industrial IoT gateway, a complete computing platform with pre-installed Debian that can truly operate in -25°C up to 70°C wide temperature conditions. Featuring a variety of input and output connections to connect to industrial sensors and devices, it has USB2.0, 10/100Mbit LAN, RS-232/ 422/ 485 ports, digital and analog ports, making it one of the more connection capable industrial IoT gateways on the market. In addition, it features industrial specialized data acquisition channels that can accept most industrial analog channels 0 ~ 10V or 4 ~ 20mA output, especially useful for legacy machinery. Many microprocessors on the market have built-in analog input channels but most of them only support 0 ~ 3.3V, which is not in the range of most industrial sensors. The Neosys IGT contains a variety of acquisition channels to connect to and collect data from In-situ sensors and OT devices. With the collected data, Neosys' industrial IoT gateway IGT series utilizes its ability to compute at the edge to offer field site decision making, data wrangling and encryption.

For data that were not processed on-site, they are encrypted and sent off via a verified network to the cloud for analytic processes. Neosys Technology offers a carrier-approved LTE Cat-6 solution that is certified to operate on AT&T and Verizon. The system is also compatible with some of the biggest names in cloud applications and packages such as C/C++, Python, Modbus, HTTP, Apache, Node-RED, etc. The sent encrypted data is processed at the cloud and displayed on an HMI dashboard to give you a supervisory view of your edge sensors and devices that can extract useful data to further improve overall system efficiency, or utilized for PdM to prevent machine failure disasters.

Neosys Technology IGT series also has customization services that can be produced in volume. The customization services include having your brand or CIS logo on the system; tailor-made operating system for your specific needs; or provide us with the desired operating system for deployment with applications ready to go; and customize the application board to suit your application needs for efficiency, monitor and management, such as customizing specific connections to connect to your legacy machinery.

Last but not least, Neosys IGT series is designed from the ground up, including its circuit design, firmware, BSP, software, certification and automation test/production. Neosys Technology also has the expertise to customize a new design to suit your needs!

Neosys Technology IGT series is the ideal industrial IoT gateway for intelligent manufacturing and PdM purposes. By deploying Neosys Technology IGT series onto your industrial IoT network to build an intelligent manufacturing factory, you can connect your existing legacy and digital devices to the same network to predict failures and reduce downtime, maximize production and efficiency while saving overall costs in the process.

PdM applications assist in predicting possible future failure outcomes using a string of existing and live data. However, one must comprehend that PdM is a continuous on-going process. The process starts with predetermining the right set of threshold data points, integrating factory floor machinery into the industrial IoT system to attain real-time data; constantly compare live data against existing data and set thresholds to live-track the finest discrepancies to avoid unforeseen machine failures. As the case with any industrial IoT system, better the data quality, the more accurate the predictive model will be ^[4].

Reference

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