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Powerful Applications of AI and IIoT

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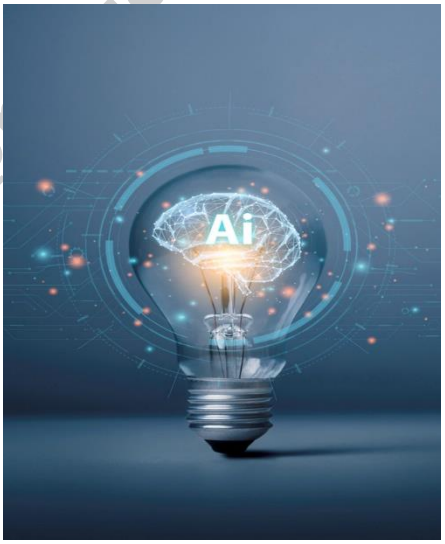

Industry 4.0 and the technologies that characterize it should not operate in isolation. Artificial intelligence (AI) and Industrial Internet of Things (IIoT), for example, are two technologies that when working in confluence with each other empower companies in the industrial sector to realize new levels of innovation, efficiency and productivity.

Incorporating AI into IIoT will enhance product quality, elevating the overall standard of manufactured goods and strengthening competitive edge through greater customer satisfaction. Simultaneously, these technologies can help companies minimize errors and reduce waste, improving safety and sustainability efforts. This article will explore the advanced use cases AI and IIoT can support, namely data-driven decision-making, predictive maintenance and visual inspection.

Data-Driven Decision-Making

Data is the lifeblood of AI. The more high-quality data AI has access to, the more efficient and accurate it becomes. At the same time, IIoT solutions, with their sensors and connected machines, produce mountains of raw data. This data is stored in a cloud environment, where companies can leverage AI to extract valuable insights, patterns, and correlations. AI and IIoT's relationship is much like the brain's relationship with the nervous system. In this comparison, the nervous system (IIoT devices) collects sensory data from its environment and relays it to the brain (AI) to interpret that information.

There are two categories of IIoT data: data about the device and data generated by the device. The former category involves data concerning the health, safety, location, and maintenance status of an IIoT device. If the device is a battery-powered sensor in the field, operators need to know the state of the device's power level. The latter category might include the data generated by a temperature sensor installed inside a refrigerated vegetable truck. These sensors will send data if the truck's internal temperature drops below a certain threshold. In this case, operators can leverage AI to automatically send an alert to operators if IIoT data indicates an irregular temperature pattern.

IIoT data holds enormous potential, and AI has the power to unlock that potential. AI can sift through oceans of IIoT-generated data at unprecedented speeds in real time, identifying trends and patterns

hidden to humans. These insights will enrich human decision-making capabilities, helping companies open new revenue streams, optimize processes for increased productivity, and identify areas of improvement. And because AI can process vast amounts of IIoT data in real-time, operations can make decisions quickly, reducing costs and preventing disasters. Likewise, AI allows businesses to use historic IIoT data for comprehensive projections and trend analysis.

However, for companies to take advantage of AI-powered analytics, they must incorporate the various elements of data orchestration. For example, rationalization is critical in cellular environments. An IIoT device should only send a reading when there is an anomaly rather than continuously because it wastes cellular data plans. Event stream processing is vital to helping operators spot and react to crossed thresholds or matched statistical patterns. Normalization aids the user in ingesting the data coming into the analytics platform. Similarly, visualization involves transforming those analytic results into dashboards or other imagining techniques that streamline trend analysis and decision-making for humans.

Enhanced Predictive Maintenance

Recall that AI can analyze IIoT data in real-time and notify personnel if the data variable passes an established threshold. While humans set the conditions for these alerts, AI eliminates the time-consuming hassle of having an employee manually monitor different machines or systems for anomalies. This process is known as real-time monitoring. By having AI automatically probe IIoT data generated from machines or product lines, companies can proactively resolve operational issues, resulting in reduced downtime and improved product quality. Subsequently, AI-driven threshold analysis and real-time monitoring of IIoT data enable predictive maintenance.

In the past, companies would perform maintenance reactively when something broke or preventatively based on projections of when something was due for repairs. Today, with the union of AI and IIoT technologies, connected machines and assets can predict the most ideal and non-disruptive time to initiate maintenance, maximizing uptime and extending the lifetime of assets. According to a report from Siemens, the average cost of downtime among large plants in 2022 was $172 million per plant annually. Thankfully, with predictive maintenance supported by IIoT and AI, companies avoid costly operational disruptions and reduce machine failures, decreasing wasteful scrap for improved sustainability.

Beyond using predictive maintenance to schedule repairs, companies can leverage IIoT sensors connected to equipment and assets to transmit critical data regarding utilization. AI solutions can then extrapolate this utilization data to help businesses improve availability and performance. Additionally, companies can utilize the IIoT data gathered via AI-enabled predictive processes to find hazards and better safeguard employees; moreover, these advanced data analysis capabilities can optimize energy consumption.

Threshold analysis isn't the only level of predictive maintenance. The other is statistical process analysis, which includes pattern recognition. While threshold analysis is essentially an enhanced anomaly detection method that triggers alerts if certain conditions exceed set limits, statistical process analysis uses sophisticated multivariate AI engines to examine time series data. In this time series method, AI and deep learning algorithms examine large pools of data, evaluating multiple variables to discover patterns. By using AI to sort through complex data connections, companies can uncover relevant trends that help boost operational efficiency and uptime. Depending on the use case and deployment, businesses should leverage an IIoT platform capable of supporting the appropriate level of predictive maintenance.

Next-Generation Visual Inspection

Another powerful use case of AI and IIoT is visual inspection. Visual inspection is a common technique in manufacturing where a person examines products, equipment, or processes to determine if there are any defects or irregularities. Visual inspection is a necessary means by which companies uphold quality control and adherence to industry standards. Today, advanced versions of visual inspection will connect AI (namely, inference engines and deep-learning techniques) and supporting cameras with an IIoT platform. The result is unparalleled accuracy, efficiency, safety, and speed that is impossible for human agents using legacy or analog processes to replicate.

These AI- and IIoT-enabled visual inspection systems can perform industrial-level image inspections without fatigue or mistakes during non-working hours, spotting minor defects that even the most thorough human operators could miss. By automating the identification of these issues, companies can (much like predictive maintenance) minimize downtime and reduce negative impacts on production schedules, increasing productivity. Greater accuracy and consistency ensure the highest product quality while delivering reliable, uniform results. Visual inspection is also vital to reducing variations in manufacturing processes.

The next generation of visual inspection can fulfill multiple industrial applications, such as objection classification and distance measurement. For logistics and safety use cases, visual inspection provides operators with immediate feedback, safety issue detection, inventory management, and opportunities for upskilling. It is also invaluable for manufacturing and automotive applications. Consider an automobile factory: when wheels get installed on a car on an assembly line, connected cameras will take photos of the wheel, and an AI and machine learning (ML) inference engine will analyze those photos to ascertain if a wheel is missing a lug nut or has any scratches. This inference engine gets trained on pictures of what the archetypical wheel should look like. When it sees any deviation from that model, it will trigger a trouble ticket for a human operator to resolve. Additionally, companies can use visual inspection and a trained inference engine to catch errors with equipment and machines to determine if something needs repairs or maintenance.

The AI- and ML-powered inference and supporting cameras must connect with an IIoT platform. This connection is essential; otherwise, when the AI makes an inference, it can't notify human personnel. In other words, without enterprise integration with business tools or applications, the visual inspection solution will have no way of generating a trouble ticket. By leveraging an IIoT platform, companies can seamlessly connect their machines and enterprise software and integrate any programmable logic controller cameras and robots with IT systems. Uniquely, some leading IIoT platforms use low-code and no-code tools, eliminating extensive developer-level programming projects and allowing companies to reap the rewards of visual inspection with minimal hassle.

Maximizing Industry 4.0 Technologies Requires Interoperability

Those industrial companies that can achieve interoperability between the different systems and technologies of Industry 4.0 will have a significant advantage over competitors. Still, getting AI to work with IIoT devices and share information requires system integration of well-developed subsystems from the vendor in conjunction with OT leaders on the factory floor. Moreover, it will require business platforms, as seen in the example of visual inspection. To that end, those organizations in the industrial and manufacturing sectors must leverage platforms and solutions that can support, facilitate and simplify the complex web of Industry 4.0 technologies.