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Accelerated industry 4.0 with AI-assisted Visual Inspections and faster Data Analytics

byteLAKE helps manufacturers improve quality, enhance process monitoring, provide predictive maintenance, and deliver smarter what-if scenarios, by combining Lenovo Edge with Intel® Distribution of OpenVINO™ toolkit and byteLAKE technologies.

Overview

Today, manufacturers are constantly pressured to increase efficiency and productivity, while improving product quality and worker safety. As an AI innovator in the manufacturing sector, byteLAKE helps manufacturers with the transformation to Industry 4.0. This requires delivering powerful AI capabilities at the edge, with servers providing outstanding performance close to the data, often in harsh environments. Leveraging Lenovo's Edge Computing, byteLAKE and Intel collaborated to increase the performance of data analytics and AI-assisted visual inspection in Industry 4.0 scenarios. This solution is focused primarily on the following two areas:

- **AI-assisted visual inspection** for efficient quality of products & process monitoring.
- **AI-powered Big Data / IoT sensors data analytics** to find trends, enable predictive maintenance, answer questions like why something happens, what will likely happen and to find the collective meaning of the data extracted from many sources.

The Opportunity: AI-assisted visual inspection in Industry 4.0

Industry 4.0 and smart factories are transforming manufacturing, delivering real-time decision making, enhanced productivity, flexibility and agility. Artificial Intelligence (AI) is giving machines abilities once reserved for humans. Its rapid adoption is driven by a constantly growing number of software frameworks, availability of a specialized hardware, and Big Data everywhere. Additionally, effective human-robot collaboration translates into increased efficiency, decreased number of defects, routine jobs automation, faster results, and numerous costs optimizations.

AI-assisted visual inspection transforms computers into intelligent machines that can identify objects, analyze scenes and activities in real-life visual environments. For instance, a camera is used to take pictures of products or production lines and AI algorithms provide analysis related to products quality, quantity or even analyze and help monitor production processes. While promising, these capabilities require significant data and compute performance, at the Edge, often in harsh environments.

The Challenge: Performance at the Edge

Performance is paramount, for AI-assisted visual inspection in Industry 4.0. For the underlying AI algorithms to be precise, they need to be optimized and generate results without latencies, often in real-time. Today's designers have access to plethora of optimization techniques to deliver optimal results, including programming tips and tricks, well documented lessons learned, software frameworks and hardware options.

However, once every reasonable improvement has been incorporated, is there a way to increase performance further? Discrete acceleration is promising for many AI workloads, but it can introduce significant power and thermal challenges, often requiring rewriting code in order to optimize performance. The challenge for byteLAKE was to improve performance, at relatively low cost., byteLAKE collaborated with Intel and Lenovo to optimize the performance of byteLAKE's Cognitive Services, with Intel's OpenVINO, on Lenovo ThinkEdge Servers.

The Solution: Lenovo ThinkEdge Servers, with ByteLake and Intel® Distribution of OpenVINO™ toolkit

To address these challenges, ByteLake collaborated with Lenovo and Intel to optimize their Cognitive Services to harness the power of the Intel® Distribution of the OpenVINO™ toolkit, running on Lenovo ThinkEdge Servers.

Powerful Edge Servers

Data processing power is a challenge at the edge, where constant insights using AI workloads are needed to make the right decisions. ThinkEdge Servers are designed to provide higher processing power at the edge. With flexible wired and wireless connectivity options, these compact edge servers are reliable for a wide variety of Edge and AI workloads, even in harsh environments.

Intel® Distribution of OpenVINO™ toolkit

A toolkit for developing applications and solutions that use deep learning, this toolkit extends workloads across Intel® hardware (including accelerators) and maximizes performance, enabling deep learning inference from edge to cloud. OpenVINO Accelerates AI workloads, including computer vision, audio, speech, language, and recommendation systems. It supports heterogeneous execution across Intel® architecture and AI accelerators—CPU, iGPU, Intel® Movidius™ Vision Processing Unit (VPU) and Intel® Gaussian & Neural Accelerator (Intel® GNA)—using a common API. It accelerates time to market via a library of functions and preoptimized kernels. The toolkit Includes optimized calls for OpenCV, OpenCL™ kernels, and other industry tools and libraries.

byteLAKE Cognitive Services

byteLAKE's Cognitive Services is a collection of Artificial Intelligence (AI) models designed to address Industry 4.0 and Restaurant's needs. Each AI model has been designed and pre-trained to be razor-focused on a specific job(s), therefore ensuring maximum accuracy.

Use Case: AI for Paper Industry

Paper production is a multi-phase process during which a natural phenomenon called Wet Line (sometimes Dry Line) is observed. AI-assisted visual inspection of the process can help efficiently detect and monitor that phenomenon. byteLAKE's Cognitive Services includes a dedicated AI model which has been designed and trained specifically for this task ("Wet Line Detector"). It can work in real-time and continuously analyze frames received from industrial cameras. AI algorithms inspect the surface where the fabric is formed and detect the so-called Wet Line. In addition, the algorithms measure and estimate the position of the Wet Line as well as its width. This information is then presented to the paper machine operator who can react accordingly and i.e., apply required settings. More about the solution can be found at: <https://www.bytelake.com/en/ai-for-paper-industry/>.

Benchmark Results

byteLAKE's "Wet Line Detector" (part of byteLAKE's Cognitive Services) has been used for the benchmarking purposes and the results are presented below. Based on these, byteLAKE's Cognitive Services has been updated accordingly.

- General configuration of the byteLAKE's Cognitive Services
- "Wet Line Detector" trained to detect Wet Line and provide its measurements
- Software highlights: DarkNet C++ OpenMP/CUDA framework, YOLO, Python
- Supported hardware infrastructure: cross-platform
- Optimization: Intel® Distribution of OpenVINO™, YOLO/Python
- Neural network / Wet Line: 23 CNN layers, 5 pooling layers, single reorg layer, single region layer
- Hardware used for inferencing (Edge AI):
 - o Lenovo ThinkEdge SE 350 Edge Server
 - o CPU: Intel® Xeon® D processor

Inferencing sequence (benchmarking procedure):

1. Load 100 images to RAM
2. <starting the timer>
3. Inferencing (all cores used): images analysis, detecting a wet line, drawing the results in RAM
4. <stopping the timer>
5. Saving the results

I/O related latencies have been eliminated and only the time of inferencing has been measured. Below results are a median for 5 consecutive trials for each configuration.

CPU inferencing results without OpenVINO (baseline):	CPU inferencing results with OpenVINO:
Detection time for all images [seconds]: 75.0 Average analysis time per image [seconds]: 0.75 FPS: 1.33	Detection time for all images [seconds]: 7.99 Average analysis time per image [seconds]: 0.08 FPS: 12.52

OpenVINO Accelerates Performance by 9.4x

OpenVINO increases the performance of the images' analysis and Wet Line detection measurements by 9.4 times. It must be noted that the acceleration is the result of software optimizations only and the hardware has not been changed for this test.

Furthermore, OpenVINO allows changing data types from FP32 to FP16. In our configuration, however, this did not have any impact on performance results. It reduced the size of the model though (by 50%). Explanation: "As CPU now supports FP16 (while internally upscaling to FP32 anyway) and because this is the best precision for a GPU target, you may want to always convert models to FP16." (source).

This solution is optimized for Lenovo's ThinkEdge SE30, SE50, SE350, and SE450 at the edge.

Conclusion

Integration with OpenVINO is a straightforward process and the effort to do so is relatively small. The results, however, are stunning. byteLAKE has not observed any decrease in accuracy. When it comes to the performance, as presented above, byteLAKE's Cognitive Services gained almost 10x improvement without any hardware upgrades. Then depending on accuracy needed and case by case this number can soar up, leading us to faster inferencing and in turn generating timely results.

“We have been using various Intel technologies at byteLAKE for many years and always been impressed by their performance and scalability offered. When designing the Cognitive Services for Industry 4.0, one of the key elements on our roadmap was to ensure maximum performance while leveraging our clients' existing infrastructure, which in many cases is based on Intel processors. Today I am excited to announce that having Intel's OpenVINO integrated into byteLAKE's products for Industry 4.0 including AI-assisted visual inspection, we not only meet the highest performance requirements but also ensure the availability of our product across various hardware configurations”, said Marcin Rojek, co-founder of byteLAKE.

Key Takeaways

- byteLAKE's Cognitive Services automate visual inspection and Big Data processing across industries. Each AI model has been designed and trained to focus on specific industrial jobs, ensuring maximum accuracy.
- This solution can be re-trained to handle a variety of scenarios related to visual inspection/quality monitoring automation, products counting, objects recognition and historic data analysis to find hidden answers in the data (i.e., trends, information about why something happened or what will likely happen and when).
- New AI models are constantly added by byteLAKE which gradually increases the number of scenarios that can be handled off-the-shelf. To do so byteLAKE collaborates with a growing number of industry/manufacturing leaders.
- Cognitive Services is an add-on to existing tools/software in factories and its integration with Lenovo ThinkEdge Servers is a straightforward process (compatibility).
- byteLAKE as single source for all components of the solution (sensors/cameras, edge devices, servers, data acquisition/processing, deployment, post-delivery customer care etc.)
- This solution is globally available through growing network of integrators
- This solution has been optimized for the Intel® Distribution of OpenVINO™ toolkit

Resources

- [Explore the Lenovo HPC and AI Innovation and Briefing Center](#)
- [Lenovo Validated Design for AI Infrastructure on ThinkSystem Servers](#)

Why Lenovo

Focused on a bold vision to deliver smarter technology for all, Lenovo is developing world-changing technologies that create a more inclusion, trustworthy, and sustainable digital society. By designing, engineering and building the world's most complete portfolio of smart devices and infrastructure, we are also leading an Intelligent Transformation – to create better experiences and opportunities for millions of customers around the world.

Why Intel

Intel CPUs are flexible processors designed to handle most AI workloads. Intel® Core™ processors are ideal for AI at the Edge, enabling AI for local cameras, robots, drones, field equipment, and other edge devices with technology tuned for low-latency inference. Since most ThinkEdge systems are Intel vPro™ platforms, they include Intel® Active Management Technology with support for remote management over Wi-Fi and over the cloud. With a range of AI capable processors supporting deployments from data centers to the edge, Intel Xeon processors are the foundation for deep learning inferencing with AI enhanced capabilities (e.g., Intel® Deep Learning Boost, Intel® AVX 512) integrated in the silicon. The Intel® Distribution OpenVINO™ provides best-in-class performance on a wide range of Intel processors, as well as other hardware platforms.

About byteLAKE

byteLAKE is a bespoke AI & HPC software company developing AI-powered solutions for enterprises. The company offers both products and services, enabling innovative, AI-powered automation and data-driven, proactive operations across various industries i.e., AI-assisted Visual Inspection and Big Data analytics for manufacturing, AI-accelerated Computational Fluid Dynamics, AI for Industry 4.0, workflow and document processing automation etc. To learn more about byteLAKE's innovations, go to byteLAKE.com.



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