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Optimizing AI Model Training and Refinement for Automated Optical Inspection (AOI)

ASRock Industrial has accelerated training and retraining of visual AI models for its AOI solution while improving the speed and accuracy of its results using the Intel® Geti™ software platform. At its own production facility, the company has enhanced printed circuit board assembly inspection efficiency by 258%, with accuracy of 97%.[1]

ASRock® Industrial

"Intel® Geti™ software eases the labor of data labeling, model training and optimization tasks. It empowers ASRock Industrial teams to produce custom AI models and retrain on demand, in a fraction of the time and with less data."

– Kenny Chang, VP of Product and Marketing Division, ASRock Industrial

As manufacturing businesses seek competitive advantage, increased efficiency on production lines is a constant and inevitable area of attention. More intelligent automation has been a key contributor to the bottom line for decades, and the current generation of AI computer vision builds further on that development. Automated Optical Inspection (AOI) augments manufacturing workflows with visual AI, reducing the burden on human operators.

Each individual implementation of an AI AOI solution requires its own bespoke AI model to identify specific features on the item being inspected. Creating the models themselves can require months of work by specialized teams, dramatically increasing project time and cost requirements. In addition, the models are subject to a continual retraining process, so optimizing the efficiency of retraining is an important contributor to the solution's total cost of ownership (TCO). As requirements for novel products and features are added to the scope of the solution, these investments must continue over time, which also compounds the value of efficiency optimizations.

ASRock Industrial uses Intel software technologies, including the Intel® Geti™ platform, to make its AI AOI solution more readily adaptable to the needs of individual implementations. The Intel Geti solution automates many of the resource-consuming tasks of that customization, making it possible to train and retrain computer vision models from fewer images, with less manual annotation and labeling. In addition, ASRock Industrial uses the Intel Distribution of OpenVINO™ toolkit to streamline model optimization and deployment, for additional efficiency benefits throughout the solution lifecycle.

The challenges of streamlining AOI

Fatigue and other human limitations are a familiar impediment to the accuracy and efficiency of visual inspection on manufacturing lines. ASRock Industrial set out to overcome those challenges with an implementation of state-of-the-art AI AOI in production of printed circuit boards at its OEM factory. The team found it challenging to collect sufficient image data to train the inspection model, and it required a tedious process to manually annotate approximately 500 images the team used initially. Annotation required ASRock Industrial to detect 12 components in each image, such as jacks, jumpers, pillars and screws, and to classify each element, slowing the pace of solution development.

The team's initial workflow included overcoming formatting issues and trying multiple model types for their use case, which consumed significant effort. Training and optimizing the model was complex and cumbersome, increasing investment in time and cost to meet their solution's speed and accuracy requirements. Ongoing refinement of the model, which is required to build the best solution possible, required expert resources, which further added to project complexity.
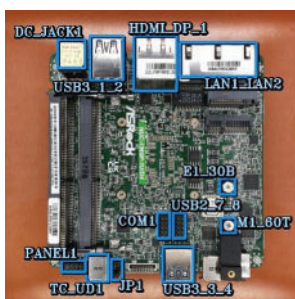
Feature annotations on ASRock Industrial PC boards.

Automation and optimization for the ASRock Industrial solution

ASRock Industrial streamlined the processes of image upload, annotation and training with the Intel Geti platform. Automated, AI-assisted annotation by the Intel Geti software helped the team iteratively train a custom neural network model. Using annotation predictions, active training and automated data collection for retraining helped the team accelerate the overall workflow to develop a working, production quality model.

ASRock Industrial was able to build and deploy the solution based on the enhanced model in just one month, compared to three months it took using the previous manual approach. Collection, annotation and training are accomplished on ASRock Industrial's iEPF-10000 Series Industrial PC, based on the 13th Gen Intel Core™ processor, equipped with a discrete GPU.

The model provided by the Intel Geti platform is automatically optimized using OpenVINO for deployment on the ASRock Industrial iEP-9020E Robust Edge AIoT platform, which is also based on the 13th Gen Intel Core processor. The solution performs inference using the CPU's integrated graphics and uses Intel Edge Insights for Industrial (Intel EII) and OpenVINO for AI inference and product inspection.

Object detection models identify the area of interest for inspection and perform image classification to determine whether the product image passes or fails the inspection criteria. Analysis of inference records helps guide retraining for ongoing refinement of the model to further increase solution quality, identifying whether the inference model is well-trained or over-fitted, for example. The Intel Geti SDK and the ASRock Industrial AI Evo engine streamline the process of automating AI AOI by gathering on-site data for automatic retraining and deployment, accelerating the process of using raw factory image data to generate, refine and redeploy AI models to the factory floor.
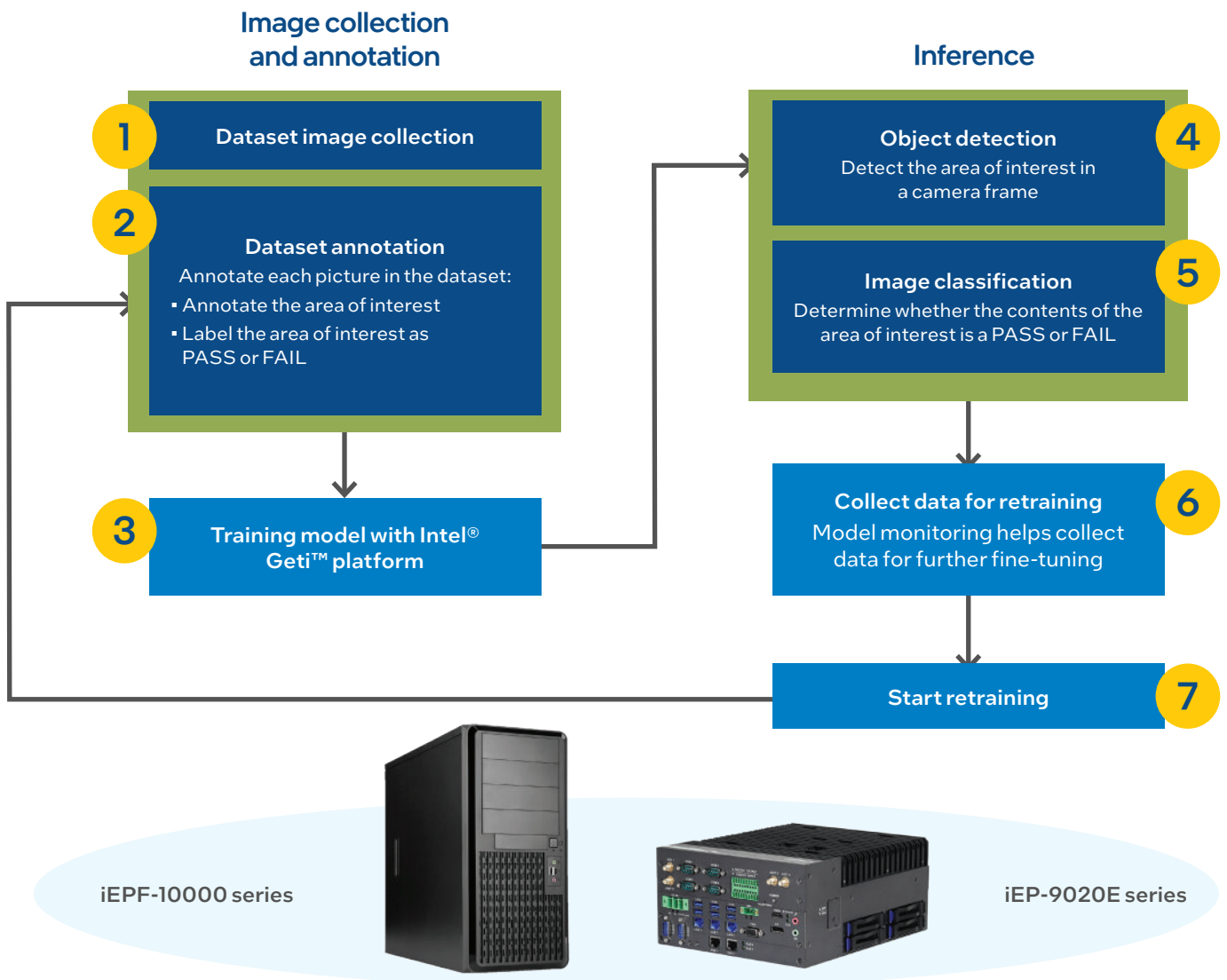
Image collection and annotation

1 Dataset image collection

2 Dataset annotation
Annotate each picture in the dataset:
- Annotate the area of interest
- Label the area of interest as PASS or FAIL

3 Training model with Intel® Geti™ platform

Inference

4 Object detection
Detect the area of interest in a camera frame

5 Image classification
Determine whether the contents of the area of interest is a PASS or FAIL

6 Collect data for retraining
Model monitoring helps collect data for further fine-tuning

7 Start retraining

iEPF-10000 series

iEP-9020E series

Image collection, labeling and inference workflow.

Benefits across the AOI lifecycle

Adoption of Intel Geti software is instrumental to the commercial viability of ASRock Industrial's AI AOI solution, driving down image collection and annotation requirements as well as streamlining retraining. In production, the solution built on those benefits with a faster inspection rate compared to the manual process.[2] Manual inspection required two operators and 44 seconds for the same work the AI AOI solution completes with just one operator in 17 seconds.[3]

ASRock Industrial is refining and generalizing this approach to be applicable beyond its initial usage for AOI on printed circuit boards. Drawing on the domain expertise of diverse solution integrators, the technology promises to deliver value beyond AI AOI, such as for robotic control systems, industrial automation and smart cities. This extensibility is key to the Intel Geti platform's value proposition for ASRock Industrial, enabling the AI AOI solution to be adapted for additional internal usages as well as to be productized for use by third parties.

Learn More

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Intel Industry 4.0 and Smart Manufacturing

Learn more about the Intel Geti platform and how you can build vision models at scale at geti.intel.com

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