WHITEPAPER

Simplifying AI Deployment for Quality Inspection

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Introduction

Artificial intelligence (AI) brings promises of reduced costs and increased efficiencies for vision applications, equally balanced by concerns over complexity and usability among other factors. This whitepaper discusses the basics around AI and machine learning, and common deployment concerns for organizations. It then introduces the concept of hybrid AI, which aims to ease deployment by simplifying algorithm development and training while allowing designers to introduced machine learning capabilities while retaining existing infrastructure and processes.

Understanding AI and Machine Learning

Artificial intelligence (AI) is one of the most hyped technologies of recent years, and while it promises new cost and process benefits for inspection applications deployment remains a challenge.

Alan Turing is considered by many to be the father of artificial intelligence. Born in London in 1928, Turing led a fascinating career that included devising techniques to crack coded enemy messages during the Second World War. Among a lifetime of achievements, he designed one of the first electronic stored-program all-purpose digital computers. Developing an interest in more abstract mathematics, Turing's paper "Computing Machinery and Intelligence" defined a standard for a machine to be called "intelligent" and suggested it would be valuable to teach a computer program by simulating a child's mind and subjecting it to a course of education.

Part of the technology trepidation stems from uncertainty around the terms and definitions of 'AI' and 'machine learning'. Organizations are also unsure how to deploy new AI capabilities alongside existing infrastructure and processes. This is especially true in inspection systems, where there are significant investments in cameras, specialized sensors, and analysis software with well-established processes for end-users. The cost and complexity of algorithm training is also a concern for businesses evaluating AI.

At its most basic, AI is the ability for a machine to perform cognitive functions that we associate with our human mind, such as recognizing and learning. Machine learning, a subset of AI, involves coding a computer to process structured data and make decisions without constant human supervision.

Once programmed with machine learning capabilities, a system can choose between types of answers and predict continuous values. Machine learning programs become progressively better as they access more data, but still require human oversight to correct their mistakes.

While AI is often seen as an emerging technology it already surrounds us in our consumer lives, particularly home sensor network systems. A "smart" thermostat, for example, uses a combination of user-inputted data and monitored human activity to determine when we're home, away, or inactive to set its estimated ideal temperature. Occasionally, the homeowner still needs to manually correct thermostat settings.

Machine learning still requires human input to make informed decisions and needs further programming to fix mistakes. Deep learning goes one step further, with algorithms that use a wider range of structured and unstructured data to make independent decisions and can learn from mistakes and adapt without requiring human programming. Autonomous applications, including emerging passenger vehicles to factory robotics, use deep learning to navigate consistently changing situations.

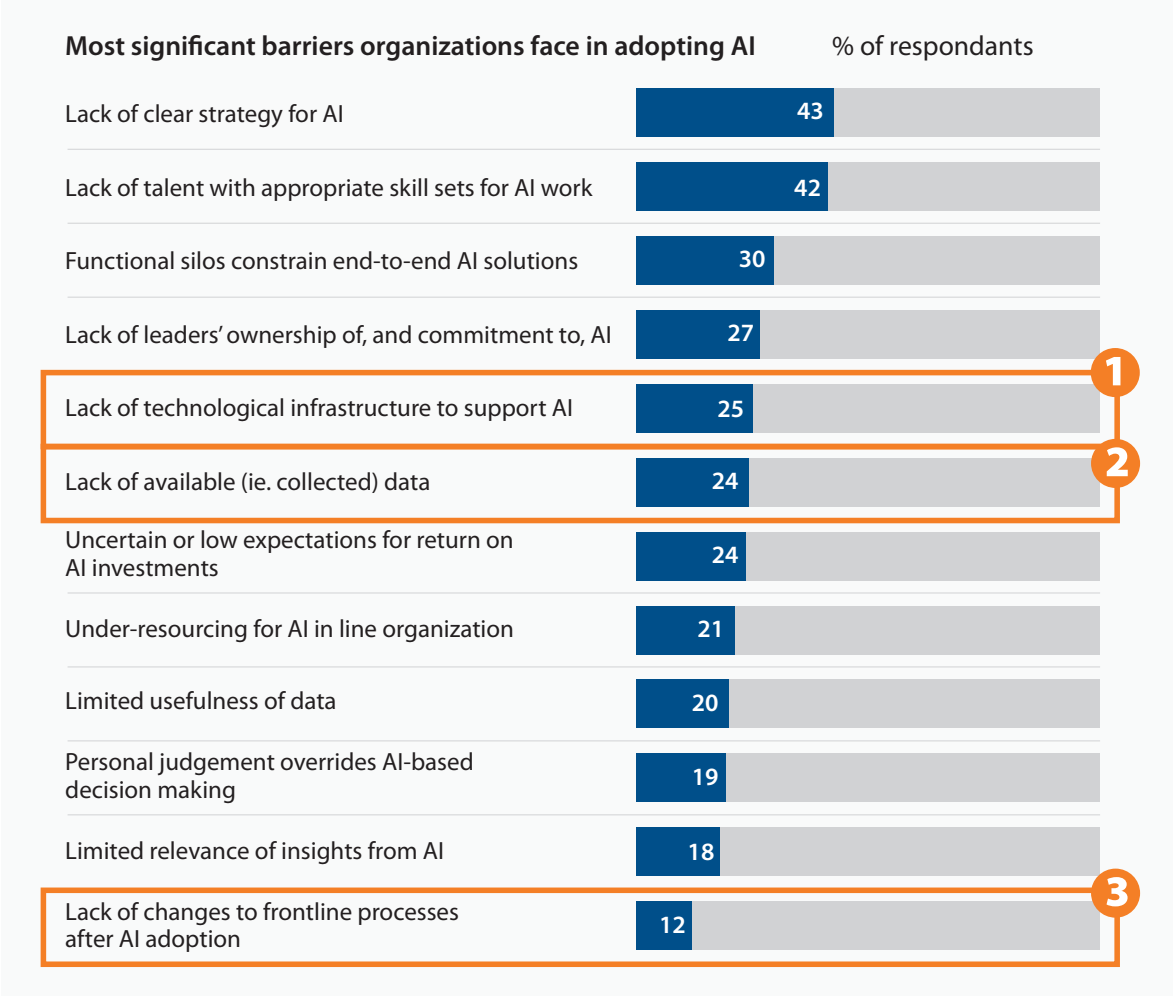
Common AI Deployment Challenges

A recent survey on AI deployment across a broad base of industries highlighted that many share the same concerns about deploying new technology. Topping the list, many surveyed highlight an unclear strategy on AI deployment and lack of skills with their existing workforce.

Further down the list, but still a concern for about a quarter of respondents, was technology infrastructure and lack of collected available data. Unlike many in this broad industry survey, the vision market already has the infrastructure in place and a large data set at its disposal. The concern is deploying new capabilities without replacing existing cameras, sensors, and processors, and effectively managing the data set to effectively train machine learning algorithms.

Interestingly, near the bottom of concerns in a broader survey is the impact on frontline processes. Common feedback for those considering new capabilities in a vision application is the need to adapt AI to how employees are currently work, versus adapting employees to how AI works. In a visual inspection application, for example, there are both human and software processes that deliver proven results. The goal of AI is often enhancing this decision-making, not always replacing it.

Considering these broad concerns, a hybrid AI approach satisfies issues related to infrastructure and processes, while a plug-in training greatly simplifies the use of existing data for algorithm development.



Three key requirements essential to an AI strategy — infrastructure, data, and processes — are also a barrier to adoption

Hybrid AI for Inspection

AI is complex, but adopting a hybrid approach that marries classic and machine learning techniques for quality inspection can simplify deployment.

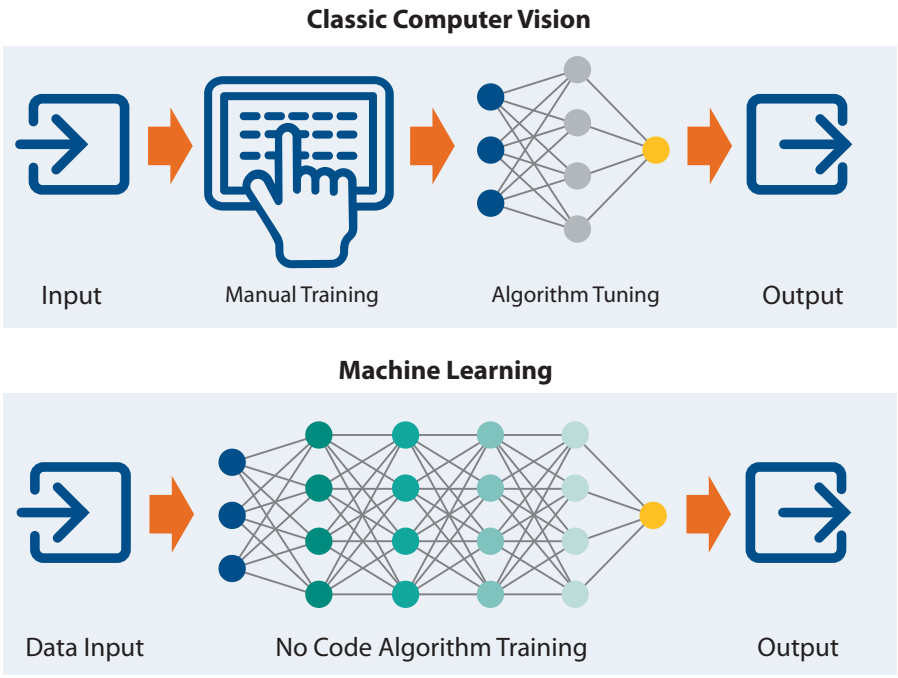


Image 1: Classic computer vision requires human input and algorithm fine-tuning to meet different requirements. In comparison, machine learning and "no code" AI software training packages simplify algorithm development and deployment of more flexible, adaptable inspection capabilities.

In a classic computer vision application, a developer manually tunes an algorithm for the job to be done. This can require significant customization if customers or products A and B have different thresholds on what is considered an error. Inaccuracies may generate excessive false positives that stop production and force costly manual secondary inspection, or missed errors that result in defective or poor quality products going to market.

Similarly, AI algorithm training has traditionally required multiple time-consuming steps and dedicated coding to input images, label defects, fine-tune detection, and optimize models. More recently, companies are developing a "no code" approach to training that allows users to upload images and data captured during traditional inspection to software that automatically generates plug-in AI skills with minimal human input.

For example, plug-in AI skills can be generated for machine learning-based classification, sorting, detecting, and hyperspectral capabilities. AI for inspection excels at locating, identifying, and classifying objects and segmenting scenes and defects, with less sensitivity to image variability or distortion. AI algorithms are also more easily adapted to identify different types of defects or meet unique pass/fail tolerances based on requirements for different customers without rewriting code.

From an infrastructure perspective, AI capabilities can be integrated into existing applications without changing hardware or software. In an inspection application, a gateway device intercepts the camera image feed and applies the selected plug-in AI skills. Users can also develop AI skills for custom requirements that are uploaded to the gateway. The gateway sends the AI processed data over a GigE Vision connection to the inspection and analysis application, which seamlessly receives the video as if it were still connected directly to the camera.

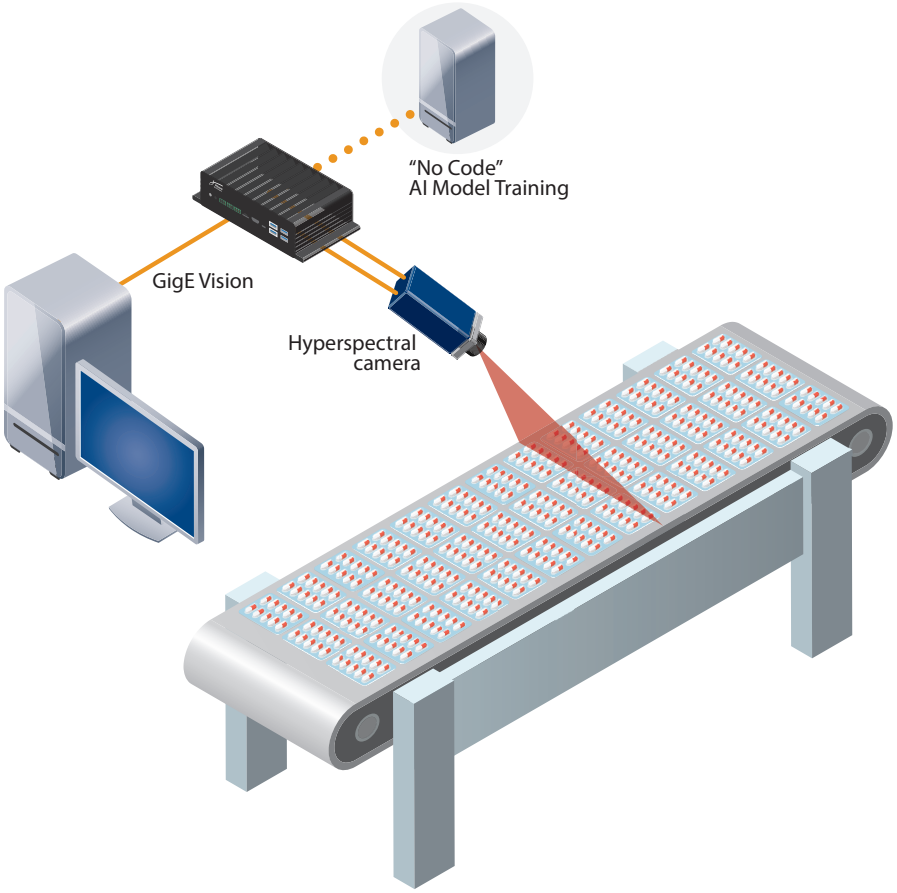


Image 2: AI plug-ins simplify the training for algorithms that are deployed on hardware that sits seamlessly between image sources and processing platforms. In this example, integrators can deploy machine learning hyperspectral capabilities without any additional programming knowledge. Images and data are uploaded to training software on a host PC, which automatically generates AI models that are deployed on gateway in a production environment.

The device could also be used as a secondary inspection tool by processing imaging data with loaded plug-in skills in parallel to traditional processing tools. If a defect is detected, processed video from the gateway can confirm or reject results as a secondary inspection. For applications requiring distributed vision processing, additional gateways can be added to the system to build an AI mesh network. For example, individual gateways are configured for different defect types, with a master device combining each skill and transmitting data over GigE Vision to the processing application.

Benefits in Inspection

AI and machine learning is set to help organizations reduce costly inspection errors, false-positives, and secondary screenings that waste human resources and slow processes. Key is the ability to simplify AI algorithm training, and ensuring new machine learning-based inspection capabilities are seamlessly integrated within existing infrastructure and processes.

About the Pleora AI Gateway

Pleora's AI Gateway simplifies the deployment of advanced machine learning capabilities to improve the reliability and lower the cost of visual quality inspection. Designed to work with existing inspection hardware and software, the embedded platform integrates plug-in vision inspection AI skills, a user-friendly approach to integrate custom capabilities, and a powerful NVIDIA GPU to accelerate the development of more advanced machine learning and computer vision algorithms.

- **Smarter Inspection:** Easily employ machine learning and AI to reduce costly inspection errors, false-positives, and secondary screenings that waste human resources and slow processes
- **Preserve Investments:** Upgrade existing cameras, software, and vision algorithms while deploying AI image processing capabilities
- **Plug-in AI Skills:** Deploy AI skills without any additional programming — built-in AI classification, sorting, defect detection, and hyperspectral imaging with powerful processing to add advanced machine learning capabilities
- **Scalable for Industry 4.0:** Upload custom image processing and AI algorithms written in Python and let Pleora's OS — built on eBUS SDK — handle the rest

Learn more at:
www.pleora.com/products/artificial-intelligence/ai-gateway/

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