

Machine Vision for the Modern Manufacturer



Introduction

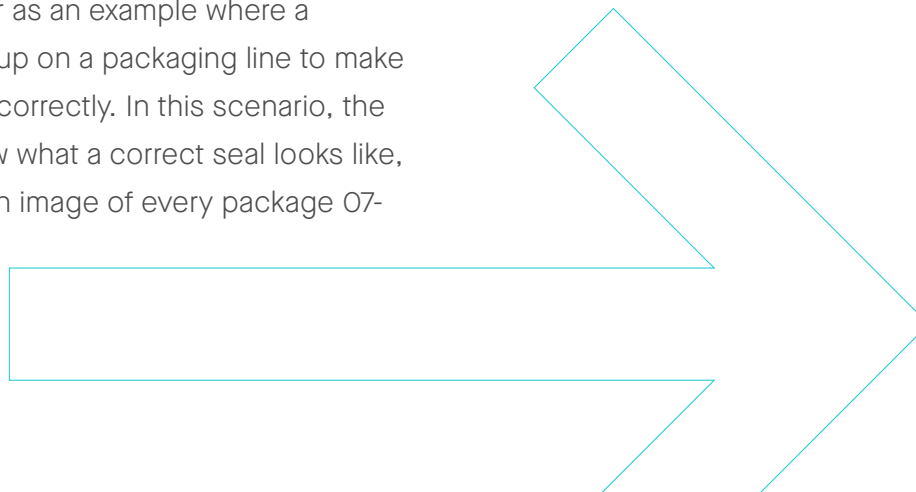
The Automated Imaging Association (AIA) defines machine vision as a combination of hardware and software that work together to provide operational guidance based on the capture and processing of images.

In simpler terms, machine vision is when a camera captures an image of a product, typically on a production line, and a software program interprets that image. If the software finds something wrong in the image, it can send a signal to the surrounding machinery to pause or stop processing, or trigger some type of alert to let the end user know that there is a problem with production.

Consider a food manufacturer as an example where a machine vision system is set up on a packaging line to make sure each package is sealed correctly. In this scenario, the vision system, trained to know what a correct seal looks like, uses the camera to capture an image of every package 07-

17-2019JF coming down the line. It quickly analyzes each image to make sure the package is sealed. Any time the seal is broken or otherwise compromised, the system can trigger a variety of actions. It could re-route the defective packages, trigger a pneumatic arm to remove the package from the line, send an alert to an operator, or even stop the production line entirely.

In this Samsara guide, we walk through the typical components found in a machine vision system as well as their business benefits. Additionally, we review how some of the key challenges facing manufacturers today are driving new requirements for modern machine vision solutions.

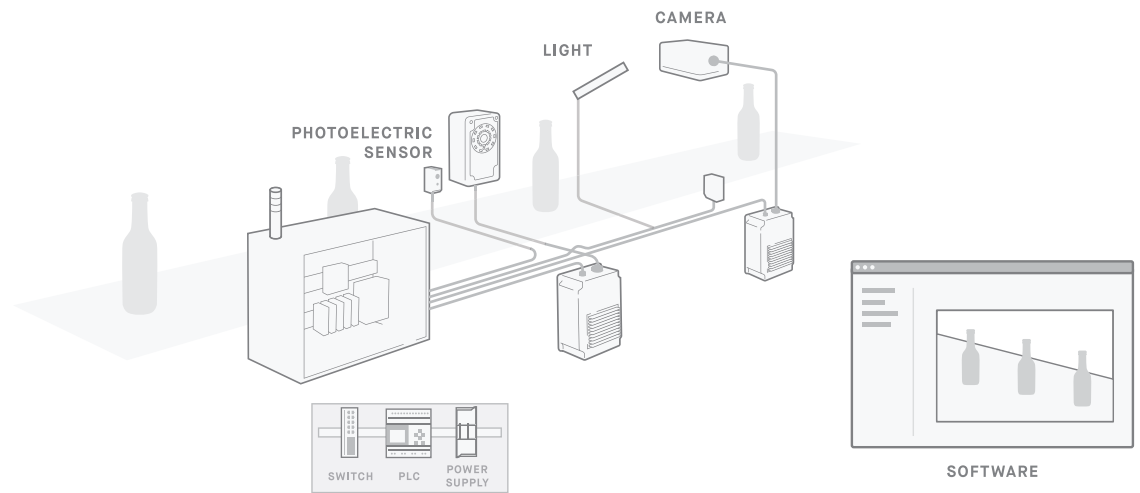


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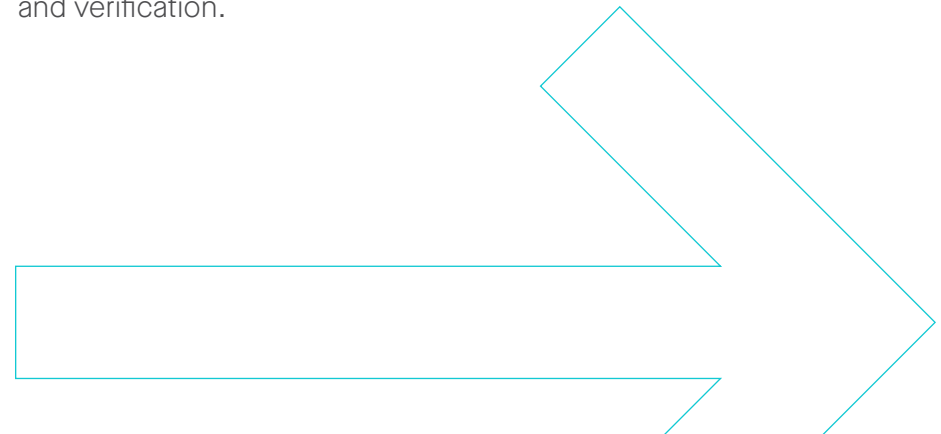
01 Components & Applications

There are a few types of vision systems ranging from build-it-yourself PC-based systems to the most popular, smart cameras, which again, combine all or nearly all of the vision system components into the camera body. Regardless, every system combines a camera, optics and lighting, the processor, and software, and it's the tight integration of each of these components that makes the technology useful and powerful. The camera and optics are used to "see" the product, but if the product isn't properly lit, even the most powerful sensors will have trouble capturing an accurate image. It's a similar story for the processor and software; even the most powerful processor will be limited by software that's difficult to use. While the processor



is responsible for interpreting the image and sending an output signal to the surrounding machinery, it's entirely dependent on the software to tell it how to interpret the image and what signal to send out.

While each system will be configured slightly differently, the types of inspections each can perform generally fall into three major categories: graphical recognition, identification, and verification.



Product Verification

Product verification helps manufacturers verify anything from seal presence, as highlighted in our earlier example, to color accuracy. This type of inspection is very powerful and can also confirm that every component or piece is present in a final product assembly, that the right number of products are included in a case, and that the product is free of flaws like scratches or dents.

Measurement programs also fall into this category. Manufacturers can also use these programs to ensure that individual parts are the right size or that they fall within a specific tolerance range. Measurement verification can be used to check that drill holes are aligned on a car part, or to make sure that a label is perfectly positioned on a product.

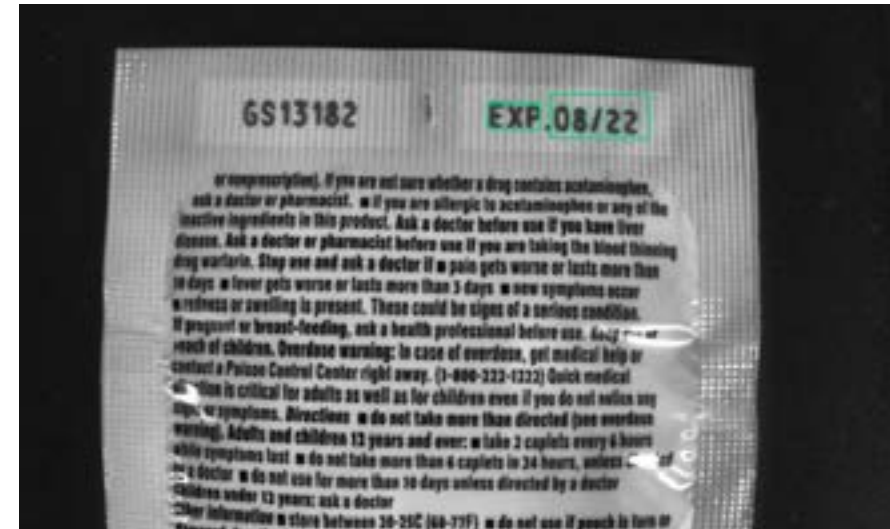


Identification

Identification encompasses any program that allows manufacturers to read, and gather data from barcodes, or text. This type of inspection can be used to verify that the correct best-by date is printed on a product's package or that the lot code specifying the product type matches the applied label. In other instances, a manufacturer may simply want to store the information it reads on each product, whether that be lot codes, barcodes, or serial numbers, as historical data that it can use for future reference.

Graphical Recognition

Finally, graphical recognition inspection allows manufacturers to match labels, parts of labels, patterns, and product components to a template. Using this type of inspection, a manufacturer could verify that the right flavor and product line labels are applied to food or consumer products that have a high likelihood of mix-ups.

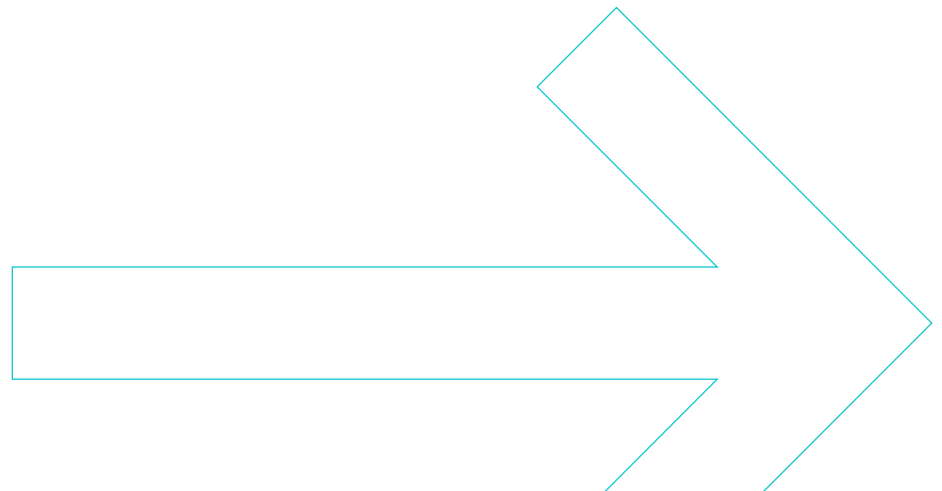




02

Benefits of Machine Vision

All in all, machine vision systems operate a lot like human inspectors on steroids. They perform many of the same tasks, but never get tired, they excel at repetition, and they can accurately inspect hundreds of products per minute without missing a beat. All too familiar with the challenges of quality management, machine vision has proven to be incredibly valuable to manufacturers.



Improved Quality & First-Pass Yield

Rather than perform sample tests by hand, machine vision allows manufacturers to inspect every single product for defects. This means a greater percentage of products are manufactured to the correct specifications the first time around leading to fewer recalls, customer returns and rejects, and regulatory fines.

Reduced Rework & Scrap

In manual inspection processes, large numbers of products are often produced with the same defect before an operator can step in to stop the line and fix the issue. A vision system, on the other hand, can automatically stop the line and alert an operator the second it identifies a single defect. As a result, fewer products must be reworked or scrapped reducing both labor and raw material costs. This is a particularly significant benefit when a vision system is used early in the production process or when high-value materials are involved.



Increased Productivity & Throughput

Not only can vision systems inspect much faster than the human eye, but they can trigger a product to be removed from a line much faster than an inspector as well. At the same time, they can help scale down the amount of labor needed across the production process. This supports manufacturers as they look to increase production speed and overall throughput.

Improved Safety & Compliance

Vision systems can be used for inspection in hazardous environments and minimize the risk of exposing employees to potentially dangerous production materials. Moreover, they can help prevent human contamination in clean rooms and in the pharmaceutical and food sectors increasing compliance with government regulations.





03

Machine Vision for the Modern Manufacturer

There is no doubt that machine vision has helped thousands of companies improve quality management and reduce waste, but historically, deploying a system has been a daunting task. The systems can still be fairly complex and many still require an experienced programmer to write out the rules for each inspection point, and since most manufacturers don't have this sort of expertise in house, they have to outsource it. Once a program is implemented, if any changes are made, for example the inspected product has a feature added, an entirely new program will have to be written again and then manually installed.

Similarly, if the manufacturer wants to use the exact same program on a different line, with a second vision system, it also has to be manually installed and optimized on-site.

For highly standardized production lines, while time and labor intensive to set up, these systems have gotten the job done, but today, manufacturing looks very different than it did when vision systems first hit the mainstream. Standardized one-size-fits-all production is being disrupted in a highly competitive market where niche upstarts are growing rapidly. And as a result, every manufacturer is still looking for the most efficient way to deliver uncompromising quality, but they're trying to do it while producing far more diverse set of products, with more changeovers and more flexibility. Even highly regulated and standardized manufacturing segments, like pharmaceuticals, are feeling the change.

In this new environment, the carefully programmed vision systems of yesterday just won't cut it. They are far too prone to breaking any time a manufacturer wants to spin up a new product. Fortunately, the architecture that underpins machine vision is being reimagined to better address today's manufacturing challenges. Below, we review the key ways in which cloud technology is transforming machine vision into a solution that can keep pace with modern manufacturing challenges.

TOP 5 MARKET CHALLENGES

Common concerns of manufacturers based on annual revenue

Less than \$100 Million

1. Market volatility
2. Labor costs
3. Material costs
4. Business regulations
5. Environmental laws and regulations

\$100 Million to \$999 Million

1. Material Costs
2. Price reduction pressures
3. Global competition
4. Market volatility
5. Transportation/logistics costs

\$1 Billion or more

1. Market volatility
2. Material costs
3. Price reduction pressures
4. Environmental laws and regulations
5. Global competition

The Future of Manufacturing: 2020 and Beyond,
IndustryWeek

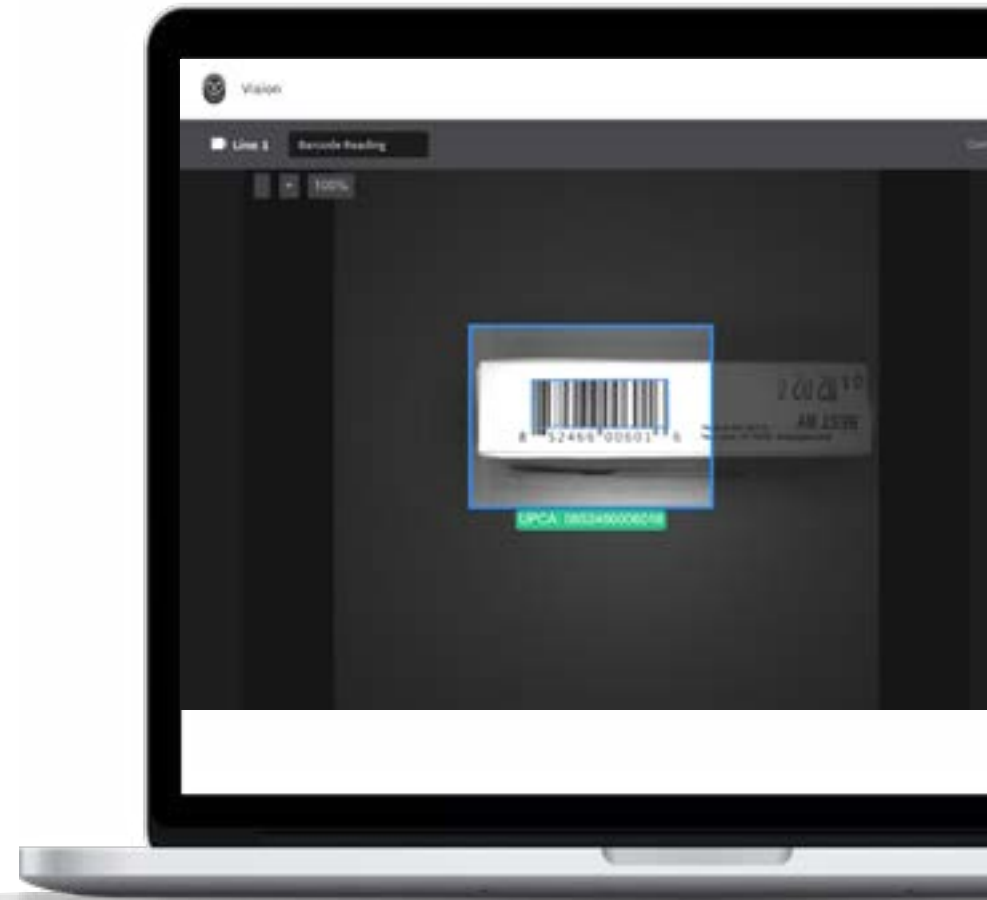
Ease of Setup & Management

Gone are the days where each vision system operated as a standalone island, difficult and time-intensive to update. Instead, by taking a cloud-managed approach, manufacturers can keep things simple, agile, and connected.

With a cloud-managed vision system, manufacturers gain secure, universal access to every camera inspection point in a single web-based dashboard. This fundamentally transforms how the vision system is set up. Inspection programs can be configured and updated in just a few clicks, without going on site and with zero coding. And with hardware components, like lighting and the camera lens that can be adjusted from a dashboard, cloud-managed systems minimize the amount of downtime between changeovers.

HOW DOES THIS COMPARE TO TRADITIONAL SOLUTIONS?

Again, traditional systems are fairly rigid, requiring engineering expertise to manually code each inspection. This added layer of complexity not only lengthens deployment times but it makes it difficult to make updates to the system. If the manufacturer lacks the required in-house engineering experience, outsourcing can also quickly get expensive.

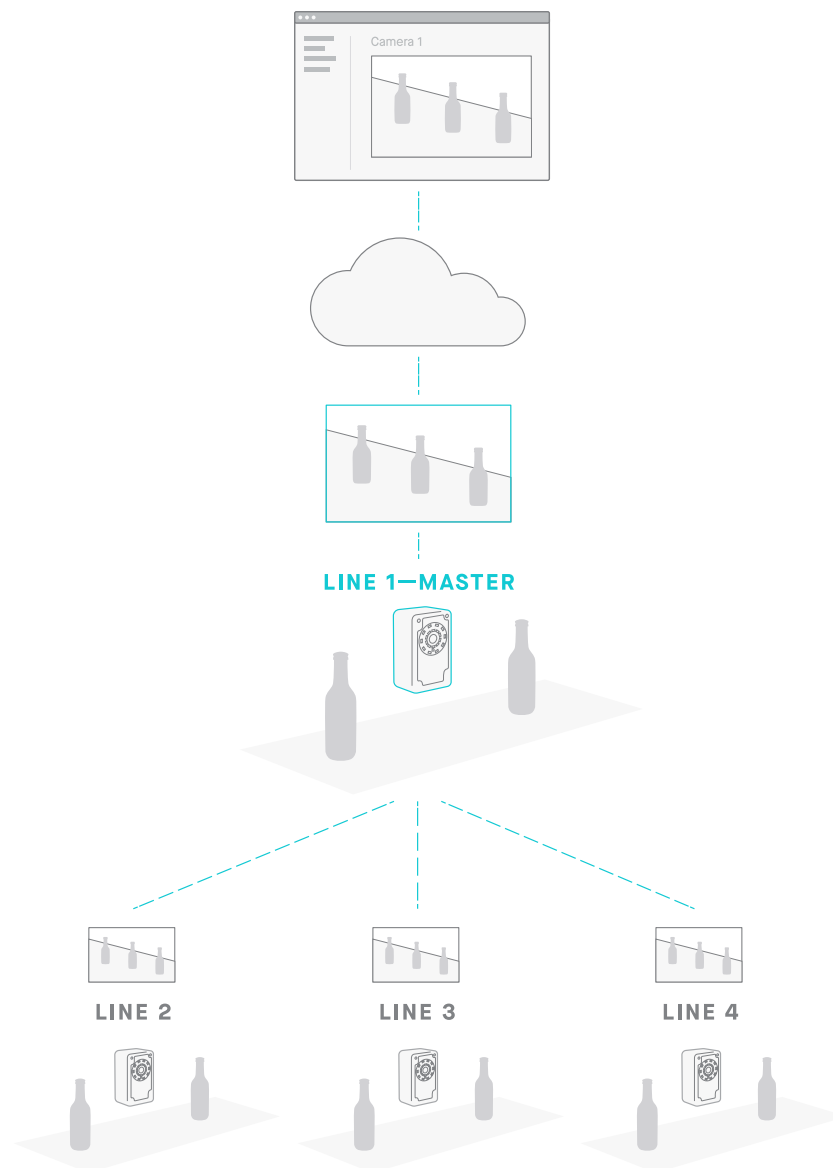


Scalability

With market volatility making it more difficult for manufacturers to predict demand, those that can scale production the fastest will gain the most upside. Fortunately, the simplified setup afforded by the cloud also makes it easier to manage volatile demand. Because every vision system is connected to the same dashboard in a cloud-based solution, once a single program is configured, it can be shared with another vision system instantly, regardless of its location. For manufacturers producing the same product across multiple sites or lines, this saves time and drives consistency in the inspection process.

HOW DOES THIS COMPARE TO TRADITIONAL SOLUTIONS?

In traditional systems, even if the manufacturer intends to run the exact same inspection program, they will have to go on-site, USB stick in hand, to upload programs manually. Some systems offer connectivity via a VPN, which allows for remote access to a single camera at a time, but they require additional IT setup.



Access to Data

The final big shift in the machine vision space is in access to inspection data. Inspection data can help manufacturers identify bottlenecks and slowdowns in the production process and take the necessary means to make time-saving, cost-cutting improvements. With cloud connectivity, data can be automatically collected and stored, no additional servers or databases required. From here, manufacturers can analyze any segment of data in the same web-based dashboards used for setting up the vision system.

HOW DOES THIS COMPARE TO TRADITIONAL SOLUTIONS?

Traditional vision systems are not well-equipped to collect, store, or provide easy access to inspection data. Instead, manufacturers typically have two options; the first is purchasing and setting up a separate database server for storing long-term data. Cost and IT lift can be prohibitive here, especially when installing systems at multiple factory sites. Alternatively, some cameras store a small amount of data that can be extracted on SD cards or USB sticks. Though less costly than a server, the amount of data storage is limited and a separate software package is typically required to analyze and understand that results.

WHY IS DATA IMPORTANT?

Data has been core to the success of some of today's fastest growing companies, and more manufacturers are starting to look to it as a competitive differentiator. According to an IndustryWeek study on the future of manufacturing, "high-growth companies rate the potential business impact of new technology higher across the board. Compared to other manufacturers, the top priorities of fast growers currently revolve around data gathering and analysis." Finding ways to not just collect but to easily manage large amounts of production data, machine vision inspection data included, will be key to long-term success in the manufacturing space, helping to solve problems faster and provide the insight needed to optimize production.

04

The Future of Machine Vision

As the pressure continues to grow for manufacturing companies to develop greater flexibility in production while still delivering quality products, the need for easier to use machine vision systems will become more important than ever. The most successful companies will rely on a single, unified infrastructure in which every one of their vision systems is universally accessible and configurable, and their valuable inspection data is easy to analyze for operational insights.



About Samsara

Samsara has emerged as one of the fastest-growing Internet of Things (IoT) companies, and as a leader in connected operations. Our machine vision system helps manufacturers streamline their quality management and run a lean operation. With fully integrated easy-to-use cloud-based software, the system is designed to simplify automated quality inspection, providing users access to every inspection point from a centralized dashboard. The cloud database and features like Cloud Sync minimize the infrastructure and resources required to scale deployments. Built-in analytics make it easy to understand production quality across any timeframe.

To learn more about Samsara and our Machine Vision System visit samsara.com/industrial.



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