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Advances in AI for Industrial Inspections

The manufacturing industry is being turned on its head as AI and deep learning (see below) the way we create goods and how quality inspection is employed. The combination of software, new deep learning techniques, power of parallel processing, and new-of-the-kind tools is at the core of this transformation.

While traditional image processing software relies on task-specific algorithms, deep learning software uses a multi-layer neural network engineering pre-trained or user-trained algorithms to recognize good and bad images or regions. Traditionally hundreds, or even thousands, of high-quality, manually classified images were needed to train the system and create a model that classifies objects with a high degree of probability. Just gathering this type of dataset has proven to be an obstacle, hindering deep learning adoption into mainstream manufacturing environments.

New technology advancements are making it easier for manufacturers to embrace deep learning as part of the inspection process. Today, we train deep learning systems with fewer bad images or even none. While deep learning software for machine vision has been around for more than a decade, it is now becoming more user-friendly and practical. As a result, manufacturers are moving from experimenting with deep learning software to implementing it.

Deep Learning vs. Traditional Methods
Deep learning is ideal for tasks that are difficult to achieve with traditional image processing methods. Typical environments that are suitable for deep learning are those where there is a lot of variation, such as lighting, noise, shape, color, and texture. For example, in food inspection, no two loaves of bread are exactly alike. Each loaf has the same ingredients, and each weighs the same amount, but the shape, color, and texture may be slightly different but still within the range of normality.

Another example may be the ripeness of an apple. Ripeness could mean color, softness, or texture. However, there is a range of possibilities where an apple is considered ripe. It is in these types of environments where deep learning shines. Other examples are inspecting the surface finish quality, controlling the presence of multiple items in a lot, detecting foreign objects, and more, to ensure quality throughout the assembly process.

A practical example showing the strength of deep learning is visible inspection on textured surfaces like metal. Some of these surfaces are too bright, and their contrast is in the same order of magnitude as that of the background (see below). Traditional techniques usually fail to locate these types of defects reliably, especially when the shape, brightness, and contrast vary from sample to sample. Figure 1 illustrates surface inspection on metal sheets. Defects are clearly shown in a heatmap which is a pseudo-color image highlighting the pixels in the location of the defect.

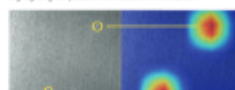


Figure 1 - Surface Inspection on Brushed Metal
Left: A pair of brushed metal with scratches (see below). Right: The heatmap output of a classification algorithm showing the defects.

Another example of defect inspection is the ability to classify a sample part as being good or bad. For instance, metal screws are objects presenting a high degree of variation on their surface making it extremely difficult for traditional algorithms to locate defects. Deep learning algorithms are very good at inspecting these type of objects as shown in Figure 2.

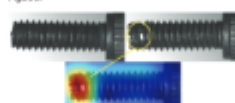


Figure 2 - Inspection of Damaged Screws
Top left: A perfect screw. Top right: A bad screw with a damaged section (see below). Bottom: Heatmap. The heatmap output of a classification algorithm showing the defect.

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