An introduction to machine vision

The eye is one of the most important organs of the human body and our skills greatly depend on our ability to see, recognise and distinguish objects and to estimate distances. Most jobs depend on our ability of visual perception. As amazing as the human sense of vision may be, we must acknowledge that today's production technologies more and more often extend well beyond the limits of human visual capacities. This is where machine vision technology comes in.

What do we actually mean when we talk about machine vision or vision technology? It does not mean graphics or design: instead, it concerns the technology of artificial vision. Cameras and computers give machines or devices the ability to actually "see", to recognise objects or situations and to make the right decisions accordingly.

Consider the following definition:

"**Vision technology** is still a relatively young discipline, which had its breakthrough in the early 1980s. It deals with images or sequences of images with the objective of manipulating and analysing them in order to a) improve image quality (contrast, colour, etc.), b) restore images (e.g. noise reduction), c) code pictures (data compression, for example) or d) understand and interpret images (image analysis, pattern recognition). Thus vision technology can be applied wherever images are generated and need to be analysed: in biology (counting cells), in medicine (interpreting CT scanning results), in the construction industry (thermographic analysis of buildings) or in security (verification of biometric dimensions). Vision technology is an interdisciplinary technology that combines lighting, optics, electronics, information technology, software and automation technology.
Machine vision refers the industrial application of vision technology. It describes the understanding and interpretation of technically obtained images for controlling production processes. It has evolved into one of the key technologies in industrial automation, which is used in virtually all manufacturing industries."* Please note: Sometimes the term machine vision is also used to refer to non-industrial applications."

Here are a just few examples for (machine) vision technology applications:

- Inspecting of the surfaces of bathtubs for scratches.
- Checking whether airbags have been properly installed into cars.
- Applying adhesives evenly and correctly.
- Verifying that welds are strong enough.
- Checking paper in the production process for flaws.
- Making sure that syringes are manufactured properly.
- Finding irregularities on flat glass.
- Guiding robots so that they can adapt to changes in their environment.
- Reading license plates of cars.
- Recognising and identifying persons.
- Reading addresses on parcels and checking their dimensions.

What are the advantages of using machine vision systems? First and foremost, the quality of the product is increased. Sample testing can often be replaced by 100 percent quality checks. In the example of paper production this means that every single square inch of paper produced has been reliably checked for flaws ‘on the fly'. The result is a superior product. The same applies to the printing of patterns on textiles or the production of

sheet metals: The manufacturer guarantees a 100 percent perfect delivery, which is especially important if products are safety-critical. Secondly, machine vision can lead to significant cost reductions. Often, vision systems are employed in the early production stages. Defective parts are immediately removed from the manufacturing process and not finished. In many cases the removed part can be re-introduced into the production process. This saves materials. Defective parts never continue on to subsequent manufacturing stages and therefore incur no further costs. At the same time the system may become ‘self-learning' in that it recognises recurrent defects. This statistical information can be fed back into the process to systematically rectify the problem at the point where it originates, resulting in increased system productivity and availability. Machine vision technology is unique in its ability to resolve the trade-off between raising quality and cutting costs. Examples abound in which machine vision does both jobs at the same time.

** taken from "Lexikon der industriellen Bildverarbeitung" by Ingmar Jahr of Vision Academy.*