‘Deep learning’ to enable new inspections with SCOUT Ai from Bucher Emhart Glass

> 'Artificial intelligence', 'Deep learning' and 'Neural networks' are just some of the expressions we are learning about day by day, and which will soon be taking us all to the next level as we learn how to harness the power and apply it into new inspection technologies.

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INTRODUCTION

This is the first installment in a short series of articles that will highlight the introduction and evolution of 'Artificial intelligence', 'Deep learning' and 'Neural networks' as it pertains to their use in glass inspection machines. In this installment, Niki Estner, Software development manager at Bucher Emhart Glass, provides two examples where the limitations of conventional machine vision to detect issues with the items being inspected proved itself difficult and marginally acceptable. In these articles, Niki will explain 'SCOUT Ai' and how it uses deep learning to enable new inspections, improve usability, increase accuracy and reduce setup times.

THE HYPE

Artificial intelligence, deep learning and neural networks have been buzzwords for more than a decade now. I always assumed they were a hype. The promises just sounded too good to be true. If you are like me, you have learned that most 'silver bullets' do not work as advertised.

THE FIRST PROJECT

My view of this technology changed radically a few years back, when I started working on a camera-based quality inspection system for a pharmaceutical product.

For this application, the customer provided us a set of good and bad samples. One of the first challenges we faced, was the fact that the inspection could only be performed when the object was already partially assembled. This made the image processing of the object to be inspected quite difficult.

To achieve an inspection accuracy rate of 80 per cent on the samples provided was easy. It took just a few days of time. Getting the results to 90 per cent took much longer. It took months and a series of updates, to achieve an accuracy rate of 95 per cent. Every fraction of a percent cost weeks of development time. This effect is widely known as the Pareto principle or the law of diminishing returns. We see it in many inspection problems: The closer you get to 100 per cent accuracy rate, the harder it becomes to gain that 0.1 per cent.

To complicate the situation, every time our customer made changes to their product, all of those painstakingly optimized parameters were no longer optimal and the detection rates (especially false rejects) deteriorated.

In this case, every false reject cost over a thousand euros of sellable product and every undetected defect could lead to an injured patient. Due to the value of the product, there was constant pressure to improve detection accuracy. After exhausting the potential of conventional inspection methods, we decided to give the deep learning 'silver bullet' a shot.

We had a few false starts. Training took a long time. Inspection hardware became more expensive. However, in the end, we came up with a deep-learning based inspection that is now detecting 99.9 per cent of all defects and 99.93 per cent of all good objects correctly.

Imagine how much development effort this result would have cost, with conventional means.

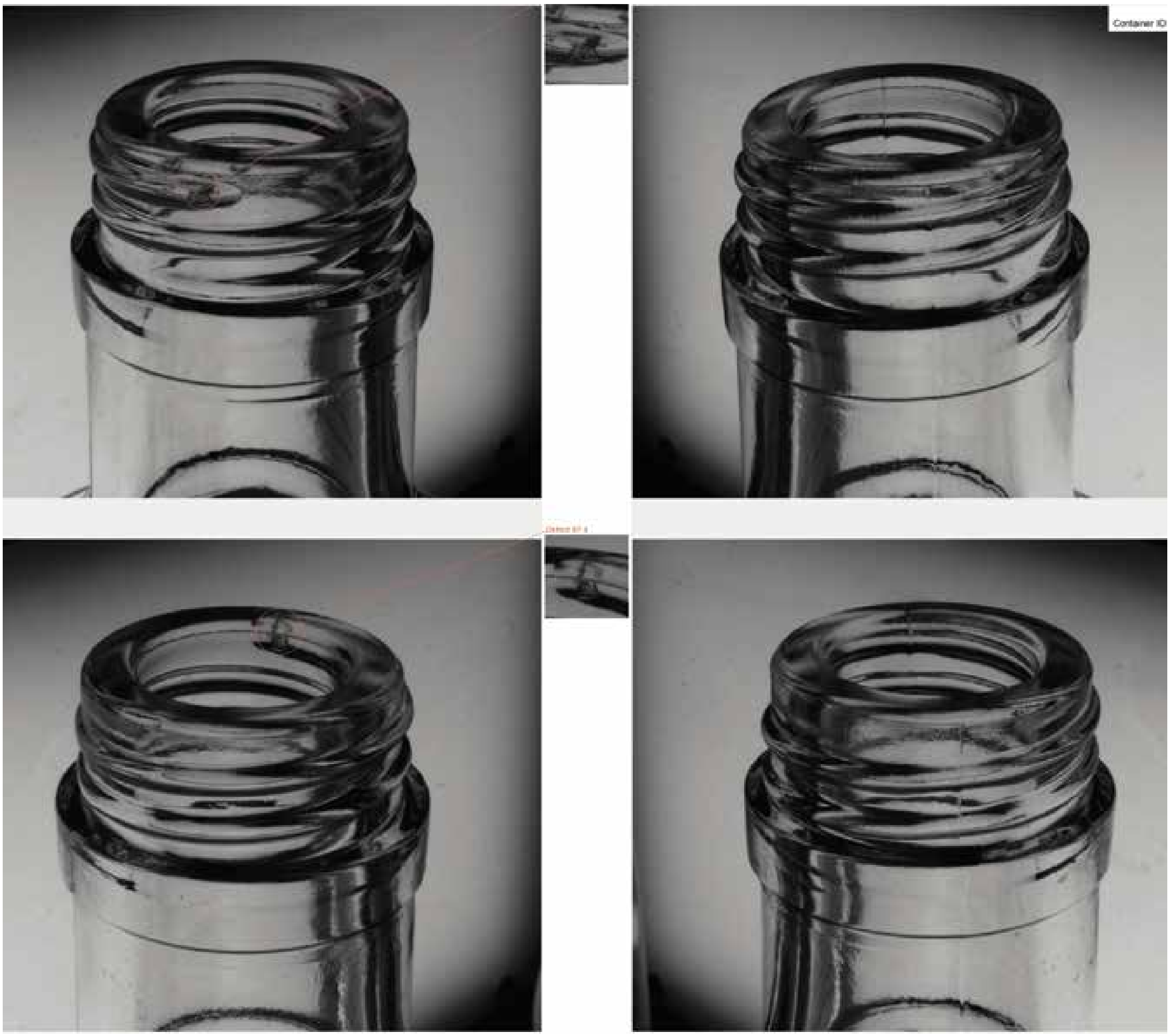
CONTAINER GLASS INDUSTRY

The pharmaceutical industry is only a small part of our product range. But with its high quality and regulatory standards, it continuously drives us to improve our inspection quality, safety, and traceability standards.

Therefore, we next started using this technology in our core business area, the container glass industry.

One of the projects we used artificial intelligence for was the thread inspection system (TID).

Inspecting the thread area is notoriously difficult as it is full of features that cause light refraction and reflection effects that make the same container look completely different in different orientations. To make it more difficult, all of



those refraction 'shadows' change over time, as the thread shaping and annealing process change.

The image above shows a small defect near the start of a thread. Finding this defect is hard for a human. It is nearly impossible with conventional inspection technology.

Even with deep learning technology, this application is difficult as some defects simply do not show up in the images. Even for a human, it can be hard to tell what is a real defect and what is a normal reflection caused by a feature in the glass. Learning to discriminate these differences, can only be accomplished using a neural network. With every new training image, the network gets a little bit better at distinguishing defects from good ware. Today we have this system running in production continuously with only an occasional training update required to compensate for production variances.

SUMMARY

After years of development and testing, I can say that deep learning is not a magical 'silver bullet'. Nevertheless, it is an incredibly useful tool and it makes previously unsolvable problems solvable. The future of machine vision is here, 'Artificial intelligence', 'Deep learning' and 'Neural networks' will be taking us all to the next level as we learn how to harness the power and apply it into new inspection technologies. ■