INDUSTRIAL VISION SYSTEMS LTD

Case study

Next Generation Machine Vision – Coping with Changes in Light and Surface Quality

IVS uses dynamic digital camera control to cope with fluctuations in light and surface conditions.

Introduction

Historically engineers have been skeptical about adopting machine vision into their production processes. Mainly attributed to bad experiences with vision systems in the past, where changes in ambient light adversely affected system performance. The latest generation of IVS digital cameras and system software removes a lot of these notable issues and gives users the latest generation of machine vision which can cope more reliably with changes in light and surface quality.

In the production line of a large car manufacturer an image processing system was required to reliably identify the position and type of differing piston rods. Strong surface fluctuations from rust and debris, plus varying degrees of reflection made automated visual identification very difficult. The application was required due to the varying number of products manufactured on the modular production line; up to seven types run down the same line. To avoid tool damage on future operations it was necessary to absolutely confirm the identification and position of the piston rods prior to entering the next process.

The industry standard IVS software from Industrial Vision Systems Ltd, chosen as the preferred solution for the automated inspection of these key parts, offers the flexibility and robustness to tackle the varying lighting conditions. The latest generation of machine vision cameras and software allow changes in ambient light and surface quality changes to be addressed easily and at speed.

System Set-Up

The piston rods are traversed to the station via a fixture system. To capture the image of the part, the rod is briefly held by two pneumatic cylinders. To determine the correct type and position a number of essential inspections must take place. A piston rod always contains a large and small ‘bore’, in direct relation to each other. At the end with the small bore, a ‘nose’ feature is present. This feature is only located on one side of the rod and is used by operators and automated machinery to determine the true orientation of the part. Using this feature it is possible to ensure that the part is always transferred downstream to the next process with the small bore end leading and the nose face down. Any deviation from this is quickly communicated to the control system and the rod re-positioned accordingly.

Vision Problems

Of course nothing mentioned up to now would place too much of a strain on any modern machine vision system, however the situation changes dramatically when surface texture, reflections and rust are present on the part – all of which are very common problems. The variations range from a matt, rusty finish through to a shiny, silver finish making the machine vision task very difficult.

Variations in the Piston Rod surface:

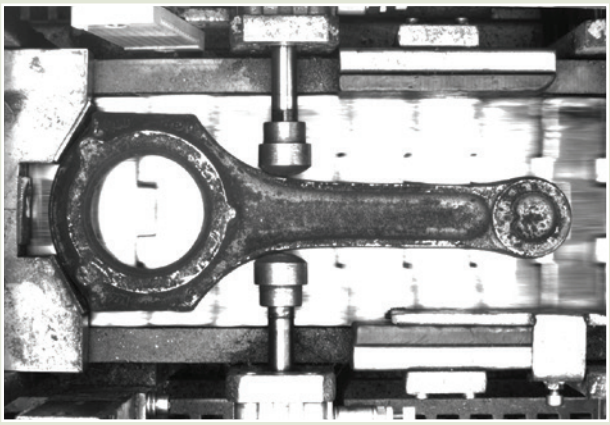
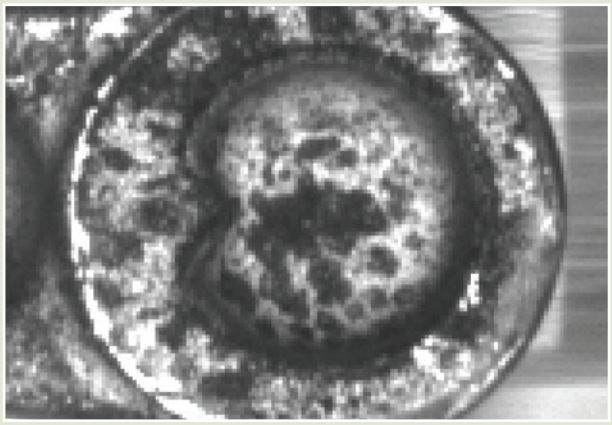


Fig 1: Rusty piston rod and nose hardly recognizably.



Cutout of the nose. Highest difficulty stage, since hardly any information for separating the nose is present due to surface defects.

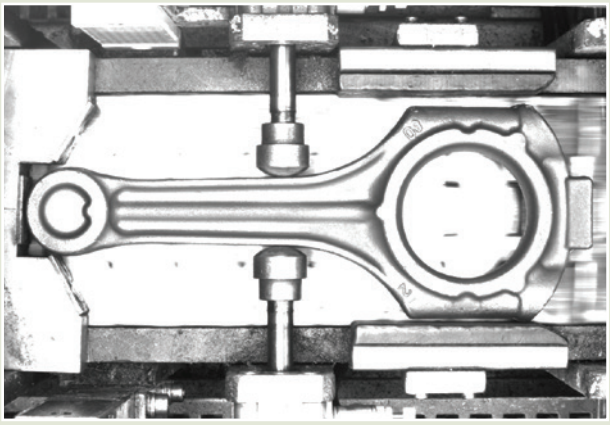
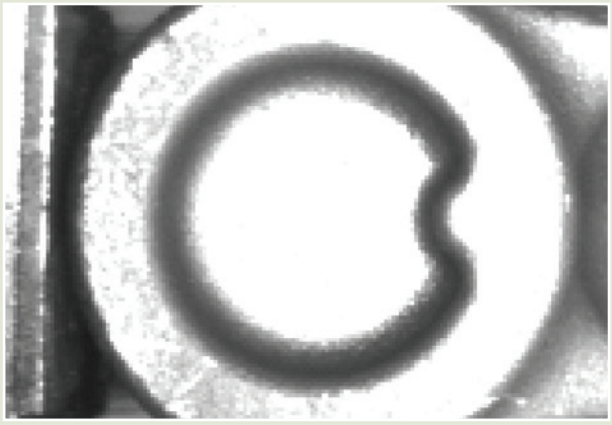


Fig 2: Highly reflective, shiny piston rod. Difficult to separate the background from the part.



Cutout of the nose. Gray levels near to the same level make identification difficult.

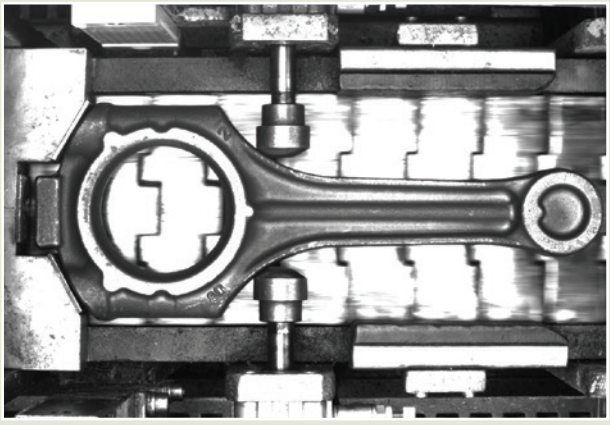
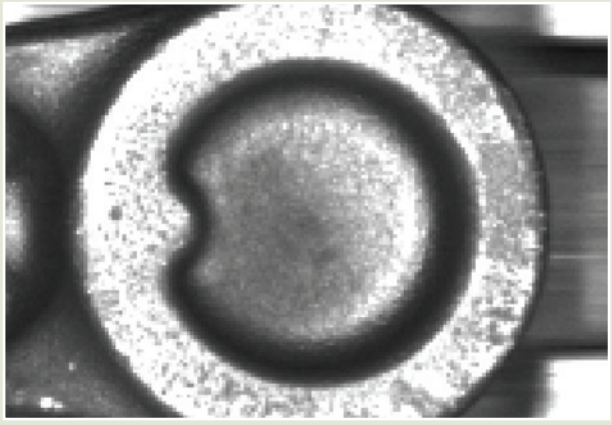


Fig 3: Good piston rod, with optimal contrast conditions between bright and dark zones.



Cutout gives optimal contrast conditions.

Case study

Solution

Optimised diffused LED lighting was used to give overall clarity to the image and offered the best overall solution given the changing surface conditions. The latest digital camera technology combined with the IVS software offers some huge technological advantages in changing surface conditions, by allowing the camera set-up to be dynamically changed dependent on the brightness and reflection of the piston rod – a step forward compared to some older vision system solutions available; and crucial for this application. The decision to dynamically change the camera set-up is automatically controlled and triggered by IVS as part of the inspection process.

Upon acquisition of an image, IVS assigns appropriate pre-processing algorithms based on the quality of the captured image. The next stage utilizes neural network classification for reliable detection of the nose and other features. Neural networks enhance the solution with the capability of cognitive intelligence. Contrary to template matching, the neural network has the ability to automatically train itself against the presented images, but does not utilize specific differences for individual samples – thus offering an advantage where surface quality is poor and changing. This information is enough to develop a system with the necessary intelligence to guarantee reliable recognition.

System Reliability

According to statements from the automotive company the system runs one hundred percent reliably. In relation to the installed system the down-times from subsequent processes could be decreased to zero due to the correct identification that the vision system provides; and as a result of this productivity has increased accordingly.

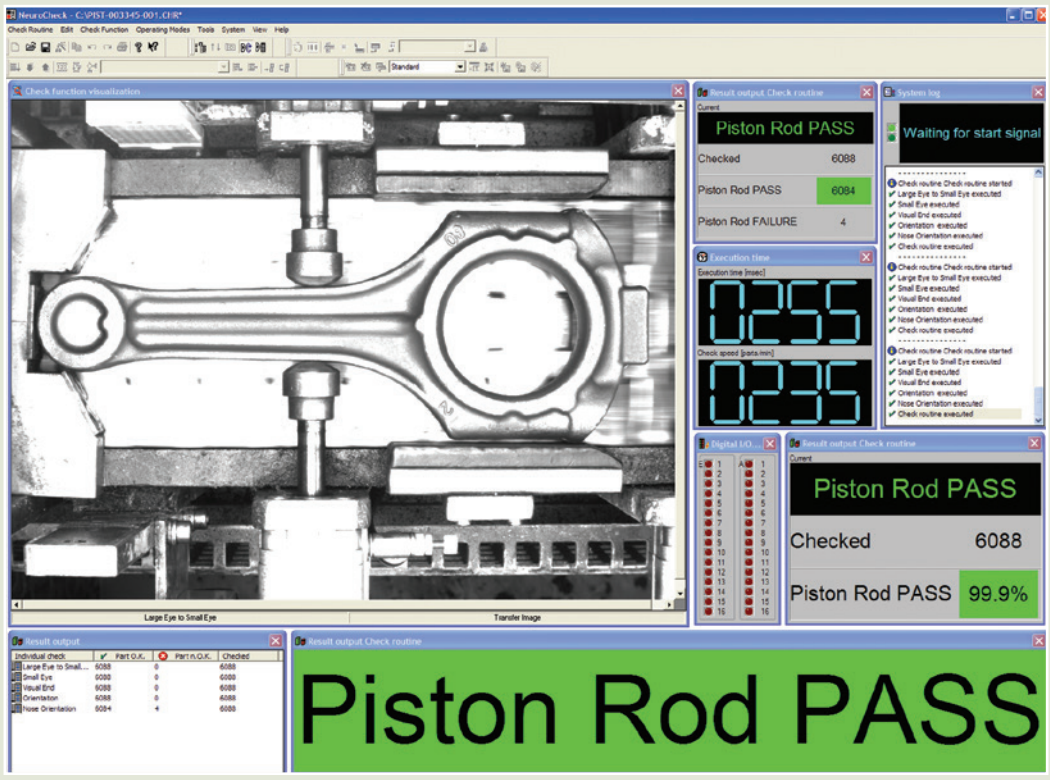


Fig 4. Example of the system in automatic operation.

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