

Machine Vision



Key Technology for Cost-Effective Automation Solutions

# Machine Vision 2007/08

Applications – Products – Suppliers



## Ready for the future



“Over 25 years ago we began to supply all production plants with 100% measurement systems because it was clear that zero-defect production of stamped parts is only possible with image processing. Therefore, then as today the following applies: precision stamping technology, unthinkable without image processing!”

Michael Stepper,  
Managing Director of  
Fritz Stepper GmbH & Co. KG

Enjoying high and rapid growth rates in all user industries and a correspondingly high innovation potential, vision systems, also called machine vision systems, are the rising stars of the industrial landscape. Step by step, they are capturing new application fields. With their versatility, this comes as no surprise: vision systems raise productivity, reduce costs, improve product quality, ensure the safety of humans and make production competitive even in countries with high wage costs.

What do we actually mean when we talk about machine vision? The term has nothing to do with graphics or design: instead, it concerns the technology of artificial vision. Cameras and computers give machines the ability to “see”, recognise and make the right decisions. The data recorded by the camera is analysed by a computer, which filters out the relevant information and passes on the results to the control unit, which responds accordingly. Is the weld on the seam acceptable or is it a safety risk?



Are all contacts soldered on to a chip? Are the surfaces of bath tubs scratched? Are the adhesives fixing the windscreen to the body correctly applied? Is the airbag properly installed? Vision systems answer all these questions, and more. Fast, with complete reliability and cost-effectively.

Surface inspection, completeness checks, measurement technology, identification and robot vision: all these are typical machine vision tasks. This innovative technology is used for a wide range of applications, even outside manufacturing, e.g. for identifying persons, in document processing and traffic engineering.

This publication gives you an overview of the typical application options and uses of this fascinating technology. 79 member companies of the German Engineering Federation VDMA have got together to form their own machine vision group.

We will gladly give you the benefit of their experience!

## Defect-free quality

Customers naturally demand defect-free goods from the producer. Visible surface defects in particular lead to costly complaints, even if the product itself works properly. But why, in many production processes, is the visual final check the only step still to be executed manually, at great effort and often only on a spot check basis? In most cases, it would be far more profitable to automate this task using machine vision.

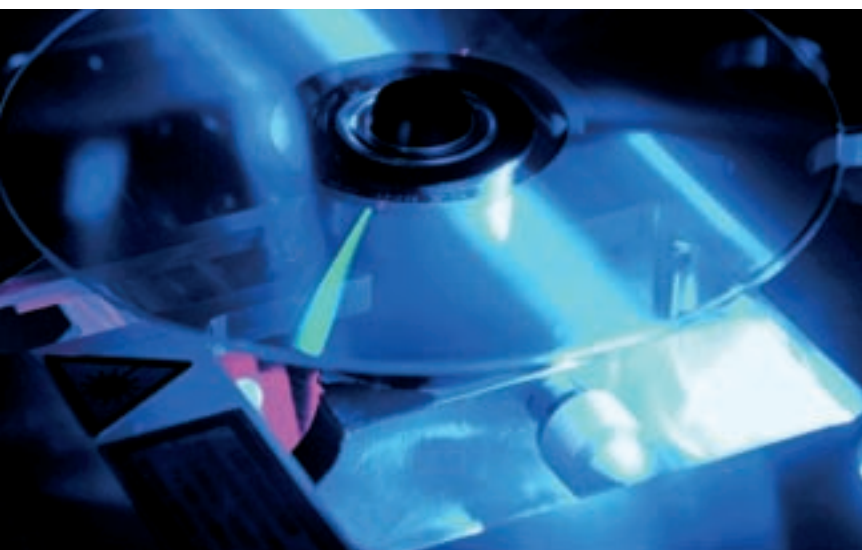
With vision systems, the 100% check is simple to automate, even where large quantities of materials are involved. There are two fundamentally different test methods currently in use for automated surface inspections:

- Defect detection in uniformly structured surfaces using a defect description (scratches, marks, holes etc.)
- Defect detection in patterns (including multicoloured ones) by comparison with a stored reference



The inspection of continuous materials (or “web inspection”) has been generally dependent on detecting the smallest of faults while maintaining high production speeds. Thanks to progress in camera technology and huge advances in computer performance levels, high inspection speeds are now efficiently achieved with high resolutions.

In recent years, colour cameras have improved in leaps and bounds in terms of their reliability, resolution and speed. Thanks to this, in the area of surface inspection an increasing number of solutions with colour inspection reach the market, such as for overprint control.



## Automated control of material flow



"Machine vision technology is rapidly developing and provides Henkel with numerous applications. In Corporate Technology we develop solutions for the Henkel supply chains to utilize digital image processing for quality assurance and process monitoring.

Ralf Reifferscheidt,  
Director Technology  
Development  
Henkel KGaA

Automation is marching on in all sectors of industry. To ensure that materials flow smoothly, machine vision systems are being used with increasing frequency. They identify the products, record and pass on information, and ensure that the relevant component is supplied in the correct position and undergoes the appropriate processing procedure. There are essentially two different applications in this sector: code and character recognition, and part and position recognition.

Code and character recognition records product markings containing specific information that is subsequently decoded by the computer. Much expertise has gone into the lighting methods and read algorithms: mould-embossed or stamped characters can be read just as reliably in machine vision as codes applied using needle embossing or inkjet/laser printers.

Typical applications are the recognition or verification of barcodes, 2D codes, OCR or handwriting, e. g. on components in the automotive and electronics industries, or on food or pharmaceutical packaging (expiry dates and batch numbers).



Parts are recognised by comparing objects with reference models or samples (contours or other specific characteristics). Parts recognition by vision systems generally also provides data on the position of the product. It is therefore particularly suited to the following applications:

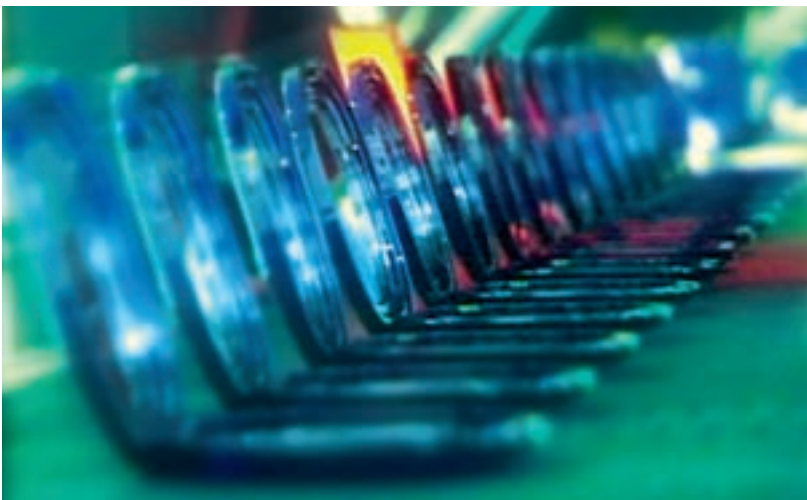
- Feeding small parts in automatic feeder devices of assembly lines
- Sorting and packaging various types of parts and materials
- Inspecting parts on automated production machines

Users benefit from highly reliable identification, which can even be achieved under harsh environmental conditions in manufacturing facilities. Reliable recognition rates can also be reproduced, even with soiled surfaces, poor-quality characters and ill-defined contours.

## Protocolled 100% check

The use of machine vision for completeness checks is especially prevalent in assembly plants. Black-and-white or colour cameras perform checks during the process or as a final check as to whether the components have been correctly assembled. They also check the presence and correct position of different components. In some cases, even surface inspection criteria are checked at the same time.

For example, where bumpers are concerned, inspection criteria include the correct assembly of headlights, indicators and the required surface finish. In the electronics industry, circuit boards are checked for correct strip conductors, soldering contacts and the complete fitting of components.



For the manufacture of safety-relevant parts such as airbags, machine vision systems enable a 100% check of production and guarantee complete traceability.

The number of perspectives required for a 100% control depends entirely on the complexity of the test object. To this end, the test system is equipped with one or more matrix cameras and a corresponding number of switchable lights. If the robot positions the test object in front of the camera, different perspectives can be generated in the image acquisition.

The completeness check is not a task designed for humans, as the work is much too monotonous and the high production speed is often too demanding for human testers. Here, a machine vision system is more reliable, faster and more economical.

## Non-contact, flexible and fast



“Benteler (Automotive) applies 3D vision technology in the production of high-precision formed sheet metal parts. The main advantages of this approach are the high measuring speed and the wealth of valuable information which we extract. This raises productivity and quality at the same time.”

Wigbert Hoffmann  
QM-Press Work, EOQ Auditor  
Benteler Automotive

Quality control – the largest application area of machine vision – comprises surface inspection, completeness checks and measurement technology.

Where precision measurement using machine vision is concerned, the size of the parts tested is not significant. Vision systems can check the dimensional accuracy of electronic modules in micrometers or perform gap measurement of entire car bodies three-dimensionally.

Compared to tactile approaches, machine vision measurement offers numerous advantages: the measurement is non-contact, extremely fast and can be performed in the production cycle. Instead of taking random samples and inserting them in measurement machines, the vision system works “inline” and reliably measures each individual component, without restricting production speeds.



Two-dimensional information (length, width, diameter etc.) is relatively easy to obtain using back light, which is not always possible depending on the production environment. Frequently, measurements have to be performed using incident light. Here, effects such as parallax errors or differently reflecting surfaces are reliably counteracted by precise calibrating procedures, high-quality optics and safe correction algorithms.

At the cutting edge are 3D techniques such as light sectioning or stereometric methods to measure welded seams, formed sheet metal parts and entire vehicles. These non-contact processes deliver precise measurements on a par with the results of tactile measuring systems – except that measurements based on vision systems are obtained considerably faster and more flexibly.



## Efficient and flexible



“Rhein-Nadel Automation GmbH is the leading supplier in the field of vibration-based feeding technology. We increasingly apply vision technology when it comes to feeding part families in small to medium batch sizes. The standardised combination of visual part recognition with robotics provides a very good extension of our product range.”

Benedict Borggreve  
Managing Director,  
Rhein-Nadel  
Automation GmbH

As the name implies, a robot vision system is the eye of the robot. Its most important tasks include determining the position, establishing the gripping point and precisely positioning each component based on its geometry. Once the robot's vision system has identified the object type and recognised its position, reliable handling is ensured – an important prerequisite for automated production.



One of the special features of robot vision systems is that the spatial coordination systems of the robot and machine vision are tuned to each other and the machine vision system is precisely calibrated. Communication between the systems is standardised and simple.



The focal point of possible areas of application is the fully automated assembly line. Robot vision systems offer a high degree of flexibility of the overall system, combined with enhanced positioning accuracy and production quality.

As well as the precise determination of the position, faults in the feeding system or foreign parts are immediately recognised and the system halted before damage ensues. Mechanical high-precision and, therefore, expensive feeding systems can thus be eliminated.

Typical applications include:

- Guided and optimised application of adhesives
- Best-fit assembly of windscreens
- Improved welding quality by determining the exact position during robot-executed welding
- Palletisation and depalletisation, e.g. in engine production
- Positioning of components, e.g. in PCB or mobile phone assembly

“Seeing” robots are already making production more flexible and efficient. In the near future, they will interact directly with humans and work hand in hand with them as production assistants in a shared workspace without protective fences.

## Machine vision in security, medicine, traffic control



“UPS broadly applies machine vision technology in its global logistics centers. By doing so we focus on quality as machine vision technology offers a level of flexibility, process stability and traceability which cannot be reached with conventional reading systems. Therefore this technology plays a major role in raising our competitiveness.”

Ronald Schmidt,  
Automation Manager,  
Plant Engineering Department  
UPS Europe Region,  
United Parcel Service Deutschland Inc. & Co. OHG

Machine vision technology is increasingly being deployed outside the factory – in medical practices, laboratories, on motorways or in car parks, in banks and public places, in retail logistics. These non-manufacturing applications already constitute a quarter of the total sales for the machine vision sector, proving that this technology is behind innovations in virtually every aspect of daily life.

Examples of non-manufacturing machine vision applications are:

- Automated blood cell counts
- Reading licence plates
- Biometric access surveillance and face recognition
- Automatic recognition of suspicious activities in public places (e. g. leaving a suitcase unattended)
- Reading lottery tickets or remittance slips
- Post sorting and parcels logistics
- Machine vision systems for in-car driver assistance

The benefits of machine vision also fully apply beyond industrial production, delivering improved safety and optimised processes. The potential of this technology in these areas is far from exhausted and more innovations are on the horizon.



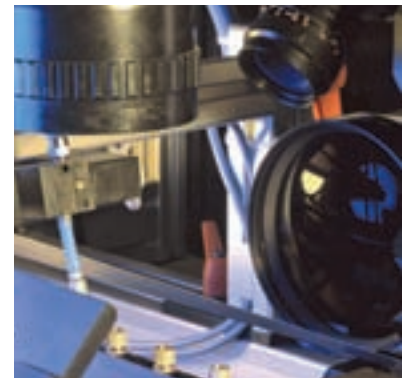
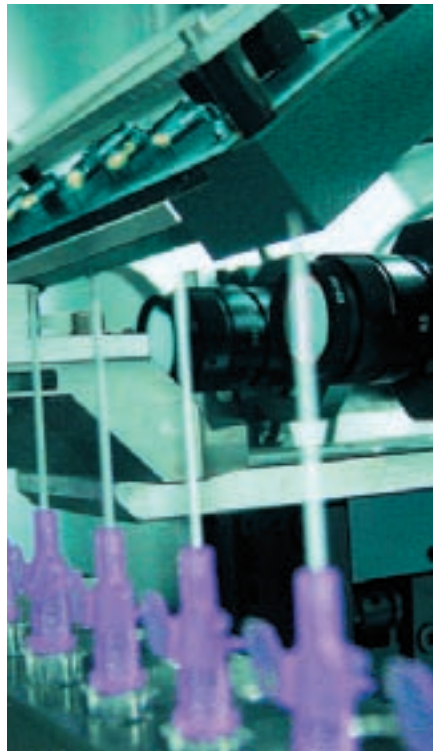
## Database containing the best solutions from all sectors



“Over 80,000 different top quality seals in the Freudenberg range do indispensable work in automobiles, plants, and machines in various industrial sectors. In the light of the zero-defect policy at Freudenberg, image processing is a core technology that is implemented into production processes to monitor quality trends and process shifts. Corrective actions are initiated, even before defect causing conditions can occur.”

Dr. Jürgen Grotepaß,  
Coordinator for Vision Control,  
Freudenberg Dichtungs-  
und Schwingungstechnik  
GmbH & Co KG

The potential of machine vision technology is best revealed in the form of application reports. These describe solutions deployed by users from all industry sectors to increase their competitiveness – by reducing costs, improving quality and optimising processes. Study the finest examples of machine vision in action – whether it’s for surface inspection, completeness checks, non-contact measurement, identification or robot vision. Our database offers a user-friendly free-text search: after entering the search term, all the relevant application reports are displayed in a short list.



With one extra click, you can download, open, print and save the reports. The search term may be freely chosen. It can refer to products (“sheet metal”), applications (“3D measurement”) or technologies (“laser triangulation”) – whatever the entry, the database quickly displays the appropriate best practices and solutions.

## Machine vision – an investment that pays off



Machine vision technology is constantly moving into new areas of application. Although this positive development is partly down to the new possibilities brought by the technology, the main driving force is the cost-effectiveness of vision systems.

After all, investments must be profitable. Experience tells us that investing in machine vision applications generally pays off after just six to eighteen months. After this period, you save money every single day.

Machine vision systems identify defective parts at the earliest possible stage of production. The parts are immediately removed from the production process and are not finished. This saves costs. In many cases, the removed part can be reintroduced into the production process – which saves materials. Defective products never reach the subsequent production stages and therefore do not incur any follow-up costs.

The electronic eyes of machine vision replace visual quality control by employees at many stages of production, thus increasing availability and the reproducibility of the process. Your highly qualified staff can be deployed more productively in other areas and work more efficiently for your company and with increased motivation performing more sophisticated tasks.

Because of the complexity of highly automated production lines, there is always the risk that irregularities might temporarily bring the entire process to a standstill. Cameras constantly monitor the critical areas and reduce downtimes. In addition, the systems identify recurring defects,





which can then be systematically removed, preferably at their source. This results in increased system productivity and availability.

Machine vision brings you closer to the ultimate quality target: zero defects. Higher quality brings competitive advantages, particularly to safety-critical areas, where this leap in quality often enables companies to tap new markets. And customers are prepared to pay more for better products, whereas complaints not only mean dissatisfied customers but also additional costs.



Another point to bear in mind is that the performance of machine vision technology increases constantly. The computing power of the hardware used increases rapidly while simultaneously becoming more economical. Today's vision technology is modular and scalable: Users can choose between standardized, cost-effective systems for simpler tasks and complex systems that tackle problems effectively that were unsolvable in the past.

### You need machine vision because ...

- Your production output has a high reject rate because your product is not checked until the end
- The checking tasks are too complex for the human eye or too monotonous for the human brain
- You produce safety-critical parts and cannot afford any errors to creep in
- Miniaturised products pose new challenges to production
- You have fast-running production processes that can only be monitored on an automated basis
- You want to guide your machine flexibly to the component without spending considerable time positioning the component
- Your customer demands 100% quality – including its documentation
- You have to ensure products are traceable and identify every part

**Does any of the above apply to you?  
Then machine vision is the technology  
you need!**



### The Company

Silicon Software GmbH was founded in 1997 as production and development enterprise of the technology industry. Silicon Software is headquartered in Mannheim. The company produces off-the-shelf as well as customized OEM solutions by its hardware and software developments. Main industrial application focus is the quality inspection in automation and Machine Vision.



Intelligent Image Acquisition products

### The Product Range

Base products are the series of intelligent image acquisition and processing boards. These products cope with complex visual tasks and high speed applications in real time. Advantage of this technology is the programmability of the on-board vision processors allowing a broad possible field of applications. Complex functional units are replaced with completely different functions in fractions of seconds.



Graphical FPGA programming tool

Further focus is the VisualApplets product series. This graphical software tool dramatically eases the programming of vision processor hardware. Also software engineers will be able to generate demanded and time-critical applications on hardware in a few minutes.

### The Applications

Image processing products of Silicon Software are successfully integrated in various applications and industry sectors since long years. The advanced flexibility and the option of a subsequent adaptation, which are achieved by customized implementations, are competitive advantages in market for our customers. The use of VisualApplets, which enables a transfer of image processing steps on hardware and the release of CPU load at the same time, enables our customers to concept smaller, more efficient and less expensive systems. OEM solutions of Silicon Software are installed in Machine Vision applications as well as medical technology, video and network technology and as programmable image processor accelerator in Machine Vision cameras.

### The Concept

Increasing requests for improvements in Machine Vision require advanced, flexible and high performance solutions. Silicon Software is one of the international technology leaders with innovative product lines for a broad range of applications and as service provider for customized solutions. For this purpose Silicon Software GmbH produces image processing boards with FPGA processors for standard-PCs, as well as individual OEM products. Based on these products, solutions are realized for industrial real-time image processing in Machine Vision.

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### Executive Managers:

Dr. Ralf Lay  
Dr. Klaus-Henning Noffz

**Formation of the Company:** 1997  
**Number of Employees:** 15

### Product Profile

- Standard Frame Grabber Hardware
- Intelligent Image Processing Hardware
- OEM Product and Device Drivers Development
- Programming Tools for Vision Processors
- Programming Services

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Machine Vision

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