The perfect complement

High-efficient robotic cell with Ensenso stereo 3D camera

Globalization is speeding up product comparisons and supply cycles. The days when industrial components could easily be sold "over the counter" are gone. In the robotics market, smaller manufacturers can only prevail over market leaders in the long term through high technical competence and innovation in niche segments. 2D image processing has not been a niche for a long time. The situation is changing in the 3D sector. A 3D image processing solution in combination with 6-axis robotics also opens up new opportunities for small and medium-sized companies to establish themselves on the market. ALG Automatisierungslösungen GmbH, headquartered in Baden near Vienna, uses this combination for its applications - for example in a bin picking robotic cell with an integrated Ensenso 3D camera.

Classic "bin picking" continues to be a significant challenge for robotics. In many applications, disordered components first have to be removed from a container before they can be processed further in an orderly manner. In addition to precision, the focus lies on short cycle times and rapid amortization of the system. In this context, ALG, together with its partner Nordfels Maschinenbau GmbH, has developed a "bin picking" robot cell that guarantees all this. The concept is based on high-quality and perfectly coordinated system components - a fast Denso robot, a powerful industrial PC and an Ensenso N35 stereo 3D camera, all in combination with powerful software. In this manner, a cycle time of approx. 4 seconds per component can be achieved.

For this purpose, the 3D camera system in the cell is placed at a distance of approx. 1 metre above the container. The camera images the parts and generates a 3D point cloud of the surfaces. The point cloud can be created by stereo camera technology in a single image. This is a decisive time advantage compared to laser scanning systems. Using a sophisticated "matching procedure", the algorithm recognizes the individual components in the recorded 3D point cloud.

The part that is easiest and fastest to pick up is determined and the possible gripping points are identified. Thus, the robot controller "decides" which workpiece is to be picked and when. Furthermore, it plans a collision-free path for the robot arm. Then the parts are safely taken and transferred to the subsequent process. This is achieved by using a high-level language program in C# Visual Studio with integration of the HALCON image processing library. The direct interface between HALCON and Denso Robotics is of great advantage at this point.

It saves the user from having to program his own interfaces and facilitates communication between image processing and robot.

Perfectly balanced: Robot from Denso, powerful industrial PC,
Ensenso N35 stereo 3D camera, powerful software
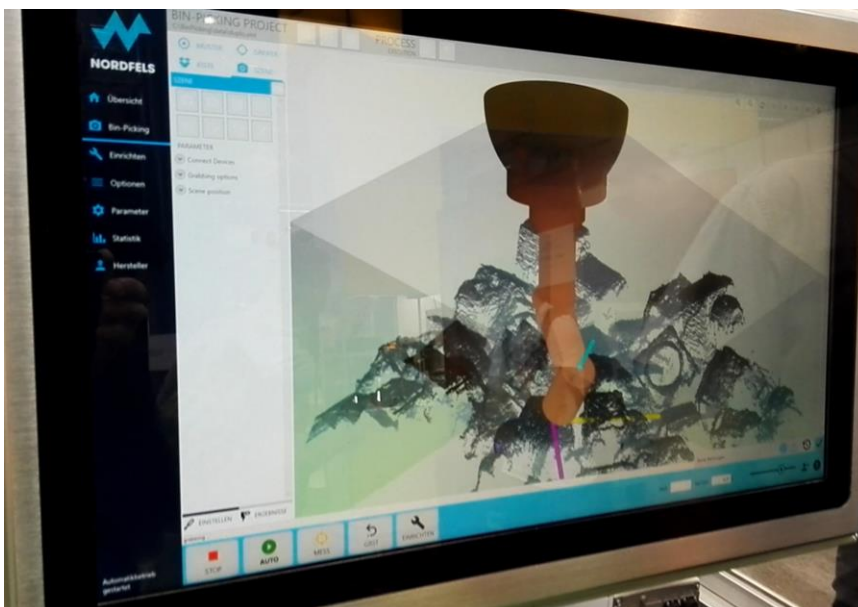
3D point cloud of the object surfaces visible from above

Fast amortisation

The system amortises itself in a comparatively short period of time with the appropriate application due to the skillful selection of the components, the fast image acquisition and the high speed of the robot. In the small parts area, amortisation can be as short as 14 months in a 3-shift operation. In addition, the compact shape and size ensure a small space requirement. At the same time, it relieves employees of monotonous, repetitive work and thus creates double space - literally and metaphorically. Thanks to its well thought-out design, the robotic cell is protected against ambient light or other external influences, making it a reliable assistant at all times.

Camera

A 3D camera is used to provide a perfect view of the workpieces that have to be picked up. The robust, compact aluminium housing of the Ensenso N35, with screw GPIO connectors for trigger and flash and GigE interface, contains two monochrome CMOS sensors (global shutter, 1280 x 1024 pixels) as well as a projector. Power-over-Ethernet enables data transfer and power supply over very long cable lengths. The 3D camera meets the requirements for protection code IP65/67 and is therefore protected against dirt, dust, water splashes or cleaning agents. The integrated FlexView projector technology enables an even higher accuracy of the point cloud and robustness of the 3D data from difficult surfaces.

Ensenso N35 models are therefore particularly suitable for the 3D acquisition of still objects and for working distances of up to 3,000 mm.

Ensenso N35 placed approx. 1 m above the container

Software in perfect synergy

The 3D camera used by ALG is a complete package consisting of hardware and corresponding software. ALG's experts use the SDK provided for the calibration and pre-commissioning of the camera. Dr. Franz Eder - Head of Robotics and Drive Technology at ALG - describes his experiences: "The great benefit of the Ensenso software package is the ability to quickly and easily operate the camera and to configure the most important basic settings. All this is always done with the same software tool, no matter which camera of which generation is currently connected".

At the same time, the robots used by Denso offer the possibility of programming directly from the HALCON environment using the HALCON Extension Package. In this way a perfect synergy between image processing software and robot control was created. New components can be programmed easily using a CAD model. This also makes setup times manageable.

Robot arm prepared for collision-free " bin picking "

Outlook

With its small footprint, high speed, easy programming of new components and associated short set-up times as well as the fast amortization time, the ALG cell shows the enormous potential of robots for flexible production lines. Thanks to the partnership with the Campus Wels of the University of Applied Sciences, Upper Austria, where the cell has now been set up and operated for one year in the Center for Smart Manufacturing, the combination of 3D image processing and robotics should also inspire the students as specialists of the future.

"The concept of the application convinced us because students can work quickly and easily with the cell, learn new parts and change parameters for optimization. This is perfect for teaching.

In addition, the Wels campus has an area of focus in mechatronics and image processing," says Thomas Schichl - Head of Automation Technology at the Center for Smart Manufacturing (Campus Wels).

For shorter product life cycles and smaller batch quantities, automation systems have to be more flexible. Robot cells perform monotonous work processes and less pleasant, uniform activities with excellence, whether it is the classic "bin picking", as described here, or the robot-based deburring of components through comparison with CAD models. The areas of application are numerous. By combining 3D image processing with human-machine cooperation technologies, the robot will become a seeing and reliable supporter of humans in the future. The human controls and monitors the production, whereas the robot takes over the physically strenuous activities. Thus, the machine does not replace the human being, but complements his abilities, e.g. by lifting heavy loads. As the incorruptible eye of the machine, 3D image processing provides the ideal basis for a wide variety of applications. Combined with the appropriate components and efficiently placed in the production process, the interaction is perfect.

Client

GmbH is a company dedicated to the perfect interplay of robotics, visualisation, control technology and linear technology. From the first planning steps, through the construction of more complex systems to the replacement or optimization of individual components, experienced experts develop optimised automation solutions. This is always with the aim of sustainably increasing the competitiveness of their customers.

www.alg-at.eu

Author

Sabine Terrasi

IDS Imaging Development Systems GmbH
Dimbacher Str. 6-8
D-74182 Obersulm
Germany

T: +49 7134 96196-0
E: s.terrasi@ids-imaging.de
W: www.ids-imaging.com

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