



KNAPP

3D camera system
in mobile robots



Cameras at the wheel

3D camera system in autonomous mobile robots

In a world adjusting to the rapid changes and advances in the fields of technology and sustainability, the need to redesign intralogistics processes is becoming increasingly urgent. With their advanced autonomous mobile robots and powerful 3D camera technology from ifm, KNAPP Industry Solutions, a subsidiary of the Austrian company KNAPP AG, which is pioneering in the field of intralogistics, is setting new standards here.

The Austrian company KNAPP is based in Hart bei Graz and specialises in the development of customised logistics solutions.

"We help our customers automate processes along the entire value chain and drive digitalisation. We are divided into various business units, e.g. Food, Fashion, Retail, Wholesale and Industry. In Industry Solutions, we serve customers in the manufacturing industry and develop autonomous mobile robots, our so-called Open Shuttles," explains **Philipp Gotzmann**, Team Lead Software Development Shuttle Control.

The 'Open Shuttle Fork' is an autonomous mobile robot (AMR) for transporting standard pallets, racks and special load carriers.

The shuttles transport goods autonomously between different production sites or storage areas. They cover a wide range of applications, from transporting heavy pallets to small materials and cartons.

Unlike AGVs (Automated Guided Vehicles), for example, which follow a fixed route, Open Shuttles fall into the category of AMRs (Autonomous Mobile Robots). They are characterised by the fact that they can cover the distance between the starting point and the destination flexibly and without a fixed route. The advantage: AMRs can quickly adapt to changing layouts and processes. As a result, the set-up time for new tasks or in case of environment changes is minimised. This adaptability makes it easy to scale up or down as required, providing a cost-effective solution in the long term.

To avoid collisions with people or objects, reliable and continuous 3D detection of the surroundings is a key component of autonomous navigation.

The O3R camera is a combined 2D/3D camera for perimeter recognition.





The O3R camera accurately detects the pallet's position and orientation, enabling precise approach and smooth pallet pickup.

Usage of the O3R camera system

The key component in achieving this outstanding level of flexibility is the 3D camera technology developed by the automation specialist ifm. With the powerful O3R camera system, the Open Shuttles can precisely detect physical objects in three dimensions and move seamlessly and safely around the production facility.

"We use the O3R camera system from ifm in our Open Shuttles to detect obstacles in the travel path. The system provides full 3D monitoring of the complete travel path over the entire height of the vehicle. This means we are able to offer additional protection on top of the certified laser scanners already in place. It also allows us, for example, to detect objects protrud-

ing into the travel path, such as fork prongs. Furthermore, 3D monitoring gives us a reliable means of detecting the passage of gates and the like. We also use the O3R system on our 'Open Shuttles Fork' for load carrier detection, i.e. to detect pallets or pallet-like load carriers. This enables us to pick up load carriers that may have slightly different positions, e.g. after they have been set down by a manual forklift truck. The 3D sensors are used to measure the load carrier and determine its exact position in order to ensure that it can be precisely approached and picked up," says Philipp Gotzmann.

"We were not looking for a turnkey system, but for a solution where we could work together with a partner on a good product and concept and develop our own algorithms and processes.

Decision in favour of ifm

When it came to choosing a suitable 3D solution, ifm's developer-friendly and customisable technology was a key factor in the decision.

"We decided to go with ifm's solution while we were still testing it in the field. This was due to the promising concept of using distributed, relatively small camera heads and a central computing unit for evaluation, allowing for in-house software development. It is very important for us at KNAPP to be able to map and influence processes that are relevant to the system ourselves, including 3D obstacle and load carrier detection. We were not looking for a turnkey system, but for a solution where we could work together with a partner on a good product and concept and develop our own algorithms and processes. This way, we remain in control and can make adjustments. One of the O3R system's advantages is that it is very developer-friendly and excellent developer documentation exists. ifm also provides libraries for custom software development, as well as the means for integrating ROS drivers and the like. We really like that. The quality of the cooperation with our colleagues at ifm also deserves special mention," recapitulates Philipp Gotzmann at KNAPP.



The Video Processing Unit is the central component of the O3R system. It offers the possibility of connecting up to 6 cameras.

The O3R system consists of a Video Processing Unit and up to six camera heads.



High-performance camera system

The O3R platform from ifm is the comprehensive solution for the centralised, synchronised processing of image and sensor information, specifically designed for use in autonomous mobile robots and other automated guided vehicle systems.

The core of the system is a powerful computing unit called Video Processing Unit (VPU). Based on a yocto-Linux and Docker architecture, open development environments such as Python, C++, CUDA and ROS are supported. The VPU evaluates information from up to 6 camera heads simultaneously and can bundle and correlate it with other important sensor information, such as that from a 2D lidar sensor, in a "sensor fusion" process to enable reliable and robust environmental perception. On this basis, efficient route planning and navigation tasks can be performed.

With up to six cameras, it is possible to achieve a seamless 360 degree coverage. The 3D cameras are also included in the platform solution. They have an aperture angle of either 60 x 45 degrees or 105 x 78 degrees and use advanced PMD time-of-flight technology.

Patented "Coded Modulation Technology" ensures reliable detection of obstacles and foreign objects, even with increased exposure to ambient light and in the presence of many other interference signals. In addition to the 3D image as a point cloud, the cameras also provide a classic 2D image of the surroundings.

The interaction of cameras and sensors enables the robust implementation of relevant functions such as collision avoidance, localisation, navigation and positioning.

Philipp Gotzmann: *"To detect obstacles, we have installed two 3D cameras on our Open Shuttles. The idea is to exploit the different advantages of the camera heads. We have installed a camera head with a field of view of 60 degrees. The focus is on covering the main driving area and achieving the best possible illumination with time-of-flight technology for the monitored area. We also use a camera head with a 105-degree field of view. This allows us to cover the full height of the vehicle, as well as the maximum ride height when loaded. In this way, we can ensure safe and secure passage through gates and the like. Our 'Open Shuttle Fork' has an*

additional camera for pallet detection. It is used to ensure that the forks are positioned precisely in the pockets of the pallet. This combination of individual camera heads and a central computing unit is a great advantage in terms of cost-effective monitoring."

Conclusion

The innovative synthesis of KNAPP's Open Shuttles with ifm's O3R camera technology is more than just a technical solution – it is an important step in the future of intralogistics. Combining flexibility, precision and adaptability, this duo sets new standards in the intralogistics value chain.

The possibility of custom design and integration of advanced sensors opens new doors to greater efficiency and sustainability in production. This example highlights not only the technological advances, but also the importance of cooperation and open exchange between companies such as KNAPP and ifm in order to meet the challenges of modern industry and actively shape the future.