

Autonomous mobile robots in warehouses

The Open Shuttles autonomous mobile robots (AMRs) from Knapp enable automation of internal transport without adjustments to an existing infrastructure. The drive solutions from Dunkermotoren and gearboxes from Framo Morat installed in the AMRs ensure safe transport of even bulky and heavy loads.

According to a Statista publication from December 2021, most B2C customers from a total of twelve European countries included in the statistics expect their goods ordered online within three to five days. In the Netherlands, one third of the customers expect their goods to arrive after just one to two days. But also, in B2B commerce, speed, flexibility, and transparency are getting increasingly important. To meet these requirements, logistics processes within an organization must be designed to be as efficient as possible. Workflows must be adapted to the fast pace of demands and requirements - and the associated logistics processes must keep pace.

A solution to these challenges is offered by the Austrian company Knapp. Open Shuttles are autonomous mobile transport robots that take over internal transport tasks without adjustments to the existing infrastructure. Thanks to an innovative fleet control software, tasks are distributed to the entire fleet of AMRs.

Traction drive

The Open Shuttle series are the flexible alternative to classic tote conveyor technology and transport totes, cartons, and trays up to 800 mm x 600 mm and a maximum payload of 100 kg. Thanks to automatic lifting and width adjustment, the shuttles can accommodate trays of different heights and widths. They are used to connect different storage areas with each other and also supply decentralized workstations.

In addition to the implemented software and smart sensor technology, the traction drive is the heart of the AMR. With its more than 70 years of experience in drive technology, Dunkermotoren, a brand of Ametek, was able to provide the right solution. The autonomous mobile robot is driven by two brushless DC motors of the BG 75 series. The attached controller ensures smooth acceleration and deceleration of the robot. A brake from the company's modular system, which is also integrated into the overall drive, ensures an immediate stop of the AMR in case of an imminent collision with other vehicles or people, which are reliably detected thanks to the integrated laser scanner.



The Open Shuttle AMRs from Knapp implement CANopen-based modular drive solutions from Dunkermotoren (Source: Dunkermotoren)

The required power for the drive is provided by the hub gearbox from Framo Morat from Eisenbach, Germany. Together, the two companies have already realized many AGV/ AMR projects. Since 2021, they have been presenting a portfolio on the market specially designed for the strict safety and space requirements of AGV solutions. The complete system of motor and gearbox is maintenance-free over the entire service life. If the tread should unexpectedly become damaged or the requirements for the wheel change due to changed ground conditions, it can be replaced and serviced directly on the vehicle.

With an acceleration torque of up to 42 Nm, the hub gearbox ensures the AMR to move even heavy loads. The emergency stop torque of 63 Nm ensures an immediate stop in case of an imminent collision. Thanks to the complete drive solution from Dunkermotoren and Framo Morath, the Open Shuttle is always moving safely and reliably.

The special feature of the drive solution is the compact design of the overall drive. The gearbox is integrated into the wheel hub and thus disappears into the drive without increasing its length.

Lifting and steering drives

The Open Shuttle Fork is the AMR model of choice when it comes to transporting entire pallets, racks, or large special load carriers. It has a payload of up to 1300 kg. The integrated automatic lift enables the load to be picked up directly from the ground and allows the load to be placed at heights of up to 1,2 m. In this AMR, the drive ▶

Logistics support from the Black Forest



(Source: Adobe Stock)

Nowadays, autonomous transport equipment, service robots, and high-speed sortation systems have taken over the sorting, collection, and transportation tasks, formerly manually performed by employees. The various transport systems move autonomously and independent of location, in some cases they move free navigating. This requires that the vehicle is “smart” and battery-powered. When sorting and ordering parcels, for example, fast and precise motion control is required to guide the parcels’ movement. The interaction and communication between sensors, controllers, and actuators is essential here. The required motor solutions have to offer high efficiency and thus longer battery life, to include safety functions, and to be compact in their design.

The motor solutions from Dunkermotoren (located in Bonndorf near the Black Forest, Germany) can fulfill the mentioned requirements. The compact design and modular construction of the drive system allow a wide range of combinations. The integrated motor controllers with a flexible selection of the communication system (e.g. CANopen) enable the use in almost all industrial environments. Additional safety-related functions such as a brake, independent encoder systems, or functional safety (STO function) complete the performance spectrum, especially for autonomous systems. With the IIoT brand Nexofox launched in 2021, Dunkermotoren can meet the requirements of Industry 4.0 with services such as drive-specific data evaluation and predictive maintenance.

Depending on the application, motors smaller than 50 mm with less than 50 W nominal power are offered. Especially small axes such as telescopic arms or small lifting axes rely on such motors. There are also motor solutions with a continuous output power of over 1 kW and a peak output power of up to 5 kW with a supply of 24 V_{DC} to 48 V_{DC} battery voltage. This allows loads of up to 8 tons to be moved, for example when transporting chassis in the vehicle construction. At the same time, the system can be positioned exactly within a fraction of a millimeter thanks to the integrated electronics. This is important when precise assembly or testing operations are carried out on the load.

The technical basis for this lies in compact and integrated power electronics in the motor. Due to its modular design, it enables a variety of expansion stages, allowing the motor to be adapted to the given requirements. Thus, integrated and complex sequence control is possible, which can trigger other network participants or react to their movement. Parts of the motion sequence can be relocated from the higher-level control system to the motor. The Motor Control Platform (MCP) allows communication between components via common fieldbus communication systems, such as CANopen. This diversity creates two advantages:

- ◆ The modular design generates a level of common parts to achieve a positive cost effect;
- ◆ At the platform level, the functions are almost the same and independent of communication.

In addition to communication, concepts of safe automation are also part of the drive concept. The attachment of a holding brake to fix the transport vehicle is available as standard in the company’s modular system. Installation of an independent, second encoder system can be used for safe speed monitoring. Devices for a safe stop of the vehicle in the event of a fault can be fitted as an optional extension. All these points are essential requirements for a motor solution in self-guided transport systems.

solutions from Dunkermotoren are used for both, the lifting and steering movements, giving the robot omnidirectional mobility. Thanks to the integrated CANopen electronics, the shuttle’s higher-level control system can address and control the drives.

The lifting of up to 1300 kg, is managed by the most powerful motor available in the Dunkermotoren product portfolio. A brushless DC motor of the BG 95 series with the matching planetary gearbox handles even heavy loads. The attached E 600 brake then holds the load in any desired position. If necessary, the brake is also used for an emergency stop at the full lift. As soon as a certain safety condition is breached, the engine is immediately switched off and the brake guarantees the stop.

To always keep the right course, two additional drives are installed in the shuttle as a steering unit. The smart BLDC motors of BG 66 series with planetary gearboxes are very compact and, thus, suited for use in flat vehicles. Via

integrated electronics with a CANopen interface, the motor receives commands from the higher-level controller of the AMR and can implement even minimal course adjustments of several millimeters.

The Open Shuttles can be integrated easily into existing structures and during ongoing operation. To cover seasonal peaks, additional robots can be integrated into the fleet and removed again afterwards. ◀



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