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CELLULAR TRANSPORT SYSTEMS – SHUTTLES FOR FLEXIBLE SERVICES

SHUTTLE SYSTEMS

The proportion of conveyor and storage systems for small load containers will increase continuously compared to pallet conveyor as well as storage systems. The constant reduction of shipment size and measures of storage minimization in industry and in trade form essential drivers for this development. Against this background the Fraunhofer IML is engaged in new developments in the field of container conveyor technology.

The idea

The initial idea follows the development of a rail guided container conveyor system with autonomous vehicles, which are as cost efficient as they are competitive to conventional conveyor technology (belt and roller). Moreover, the vehicles have the ability to load and unload containers to transport goods all along the way from the storage to the production area without typical cargo handling. In this manner, the vision of the "rolling box" – a self-routing container – becomes reality.

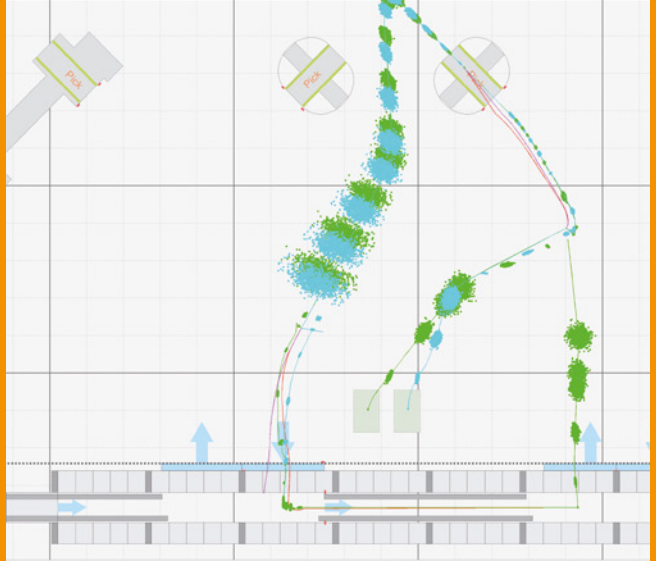
Multishuttle

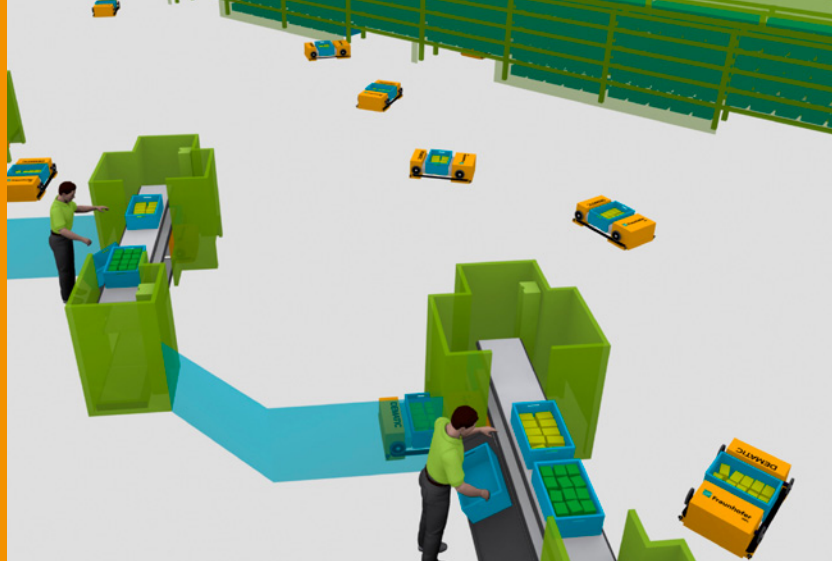
The result is a system which, concerning costs for mechanic parts, energy supply, control technology and required space, is optimized for shelf storage.
As a development partner the company Dematic distributes this system meanwhile for several years under the product name Multishuttle®. With that system, up to 600 storage and retrieval operations per hour are feasible. The Multishuttle® system has distinguishing advantages compared to conventional technologies, in most cases:

- Cargo handling and long transport distances handled by an integrated and cost efficient system
- Overhead assembly of the floor-free rail system
- Storage containers are transported from the shelf to the destination without cargo handling
- Faster conveyor speed in contrast to common roller conveyor systems
- Transport of sheet metal containers (in case of fire prevention requirements) without the emission of noise
- The number of vehicles within the system is flexibly adaptable to changing throughput needs
- Locally and temporally changing power requirements are compensable by means of dynamic commissioning
- Usage of unfavourably designed and non-block-shaped building structures

Further development

The limits of current shuttle systems are reached in case that long distances between storage and manual picking zones have to be passed. In this instance the containers are turned over on conventional conveyor technology and are transported to their destination. A disadvantage of this solution is that the conveyor technology usually does not use the shortest and direct possible route to the destination. It is rather made up of straight paths, curves, switches, junctions, sorters and buffer lines in a manner that it connects all source locations with all destinations and for instance also carries out a sequencing of the load carriers.
The Cellular Transport Systems ought to replace and extend steady conveyor systems where a high degree of flexibility and





changeability is needed. In contrast to traditional steady conveyor technology now a multitude of identical cost-effective autonomous transport vehicles transport small load carriers. Typical fields of application are small and medium distribution centres as well as production plants. The system becomes interesting for the user especially when the connection between transport source and sink has to be kept flexible, the transport throughput has to be adapted to highly fluctuant demands or the area between storage and the point of use should not be obstructed by steady conveyors.

Multishuttle Move

The new Multishuttle Move is compatible to the rail-guided Standard-Multishuttle®, but also contains an additional floor chassis. The steering mechanism on the floor is realised by a velocity difference control, a third wheel is used as a passive castor wheel. In the front and at the back of the vehicle there are laser range finders attached, which are used for safety purposes and also for navigation. The energy supply on the floor is sustained by accumulators and in rail by a conductorrail which is also used for recharching the accumulators. The load picking mechanism is identical to the Standard-Multishuttle®.

Autonomy and Swarm Intelligence

Centralized control and management systems are a repressive alternative, due to their missing flexibility and the big amount of vehicles which needed to be controlled. The coordination of the Multishuttle Move – the "Vehicle Swarm" – is executed without a central control unit. A multi agent system is used – decentralized, following the Internet of Things principle. Besides the advantage of a fast Start-Up it allows the communication between the transport entities. The decentralized control enables the Cellular Transport Systems to become scalable and changeable, since the overall performance can be adapted to demands by adding and dropping autonomously acting vehicles. The Swarm Intelligence carries out advantages e.g. at optimizing the overall throughput, due to the usage of the knowledge from each vehicle.

The intelligent localisation, navigation and collision avoidance is based on a newly developed hybrid sensor concept, consisting of dead reckoning, radio frequency ranging, distance and inertial sensors. A single shuttle is able to move on the floor autonomously without guiding paths and reacts to any kind of obstacles – also to other vehicles. The Shuttles always search for the shortest route to their destination point – this guarantees an optimal throughput – and communicate via WLAN and arrange transport orders and routing amongst each other.

Advantages of the System

Beyond all advantages of the Standard-Multishuttle® the Multishuttle Move additionally offers the opportunity to build up scalable and changeable warehouses which can be operated completely without pre-storage areas and therefore save space, costs for planning and construction. The vehicles can drive directly into and out of the rail in the lowest level of the shelf. In warehouses with multiple lanes the crosswise distribution can be done via tunnels, which then demands less space than conventional systems. The position of the picking stations can be freely adapted to the environmental conditions. For intermediate buffering and overtaking manoeuvres, e.g. for sequencing, no additional installations have to be implemented. Furthermore, the new available space can be used multifunctional, e.g. as a block storage.

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