

# Handling Technologies for Warehouse Automation

*Kitting robot for compiling assembly kits,  
which picks parts from a wide variety of  
source containers.*

## Background

Due to rising goods turnover figures, growing cost pressure and the tense labor market situation, an increasing number of logistics processes are being automated. Whether it is for assembly kit picking in production, micro-fulfilment for online purchases, preparing mixed pallets in the distribution trade or handling items in stores: Fraunhofer IPA offers a wide range of innovative and smart technologies enabling a wide variety of logistics tasks to be automated, even when it comes to complex handling processes.

## Assembly pre-picking

Assembly pre-picking is all about putting together the stock parts needed for a respective assembly step into kits (kitting). More and more, this non-value-adding process can now be automated thanks to modern handling technologies. Fraunhofer IPA has a hybrid gripping framework that offers full flexibility whatever the application. With self-configuring, **model-based gripping methods** based on CAD model data of the parts to be handled, even challenging tasks such as separating entangled components and placing them in a precise position can be accomplished. In addition, **model-free gripping** in six degrees

of freedom affords that unknown parts can be picked up directly without the need for pre-configuration. This method also allows the parts to be set down gently, albeit with less positioning accuracy. The hybrid gripping system can constantly improve itself through continuous in-process learning.

A special supplementary function is the **segmentation of packaging materials**, such as foils; this ensures that the system distinguishes between parts and packaging, especially when carrying out model-free gripping tasks, thus avoiding gripping errors.

All methods can be automatically set up, trained and verified via **simulations**. No real data is required and the trained system is directly operable on the real robot.

## Microfulfilment

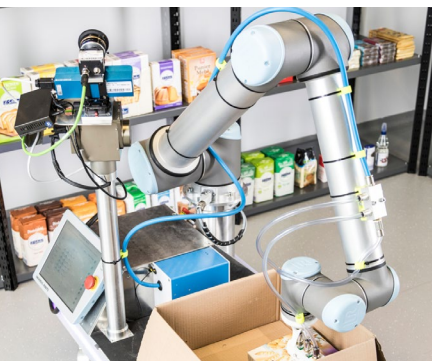
**Processing customer orders** in e-commerce, food shipping or from the production warehouse has so far mostly been only partially automated. Particularly picking up and packing goods is often done manually. Besides intelligent gripping methods, Fraunhofer IPA also offers a **scalable object recognition solution** for such tasks that unerringly identifies the desired item even in a mass of other,



*Replenishing small load  
carriers in the production  
warehouse with a mobile  
manipulator.*



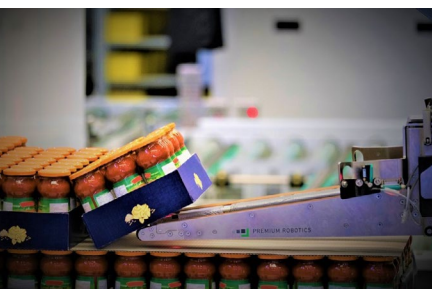
*Picking retail items with a  
mobile platform.*



*In addition to master data, the Kaptura ScanStation can also be used to generate 3D mesh models of objects as semantic digital twins. (first picture above)*

*Scalable object recognition also makes it possible to differentiate between very similar objects in real time. (second picture)*

*Sensor-guided packing of goods for dispatch. (third picture)*



*Thanks to generic pack localization, a roll-on gripper can locate and grip any type of unknown pack. (Source: Premium Robotics)*

similar items. Unlike conventional recognition systems, the algorithm recognizes new objects within the time of an hour, generates recognition models with very low memory consumption, and can be trained with just a few images of the object or a 3D scan. This means that the system can be adapted to a widely-varying selection of goods at any time.

If the goods are not only to be compiled, but also directly packed for shipping, a **sensor-guided, reactive packing planner** for 3D objects comes into play. Visually-controlled packing planning and force-controlled placement ensure that items are optimally stowed in the respective package. The sensor-guided bin-packing module is, of course, also ideally suited for end-of-line packaging tasks in the production process.

### Palletizing and depalletizing

In distribution centers, large quantities of mixed pallets are prepared from homogeneous pallets. With the aid of a robot and a **roll-on gripper**, this task can be automated with any degree of flexibility and requires very little space. The roll-on gripper can pick up one or more packs at a time, rotate them and set them down precisely on the mixed pallet.

For depalletizing any type of pack, Fraunhofer IPA has developed a **generic pack localization** solution that can also be used for new and unknown types of packs. This remarkable capability is achieved through training using a specially-created simulation program that generates packs and pack patterns.



*Handling robot for tasks in beverage logistics preparing mixed crates at the manufacturer.*

Thanks to a special gripper for **beverage crates and bottles**, the generic localization component could also be successfully used for palletizing empties in beverage stores and for preparing mixed beverage crates.

### Our services

In addition to our software modules and pick&place systems, we are more than happy to assist you with services such as potential analyses, feasibility studies, conceptual designs, implementations, and training programs right up to customized software adaptations or solutions. Benefit from our many years of experience in the field of warehouse automation.

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