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An algorithm for creating a sorting/packaging application using the Pick-Master 3 software for ABB robots

Algorytm tworzenia aplikacji sortowania/pakowania z wykorzystaniem programu PickMaster 3 dla robotów firmy ABB

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Presented is the algorithm for creating sorting and packaging applications using the PickMaster 3 application for ABB robots. The article complements ABB company materials. The creation of the application has been divided into three parts (creating lines, preparing the robot and creating the project).

KEYWORDS: robotics, sorting, packaging, PickMaster 3, Picking PowerPac

For many years, the global robotics market has been developing dynamically. This is confirmed by the results of the sale of robots presented in the reports of the International Federation of Robotics (IFR). From these data, it appears that sales on the robotics market grow by an average of 15% per year (fig. 1 and fig. 2) [3].

The number of robots being installed affects the dynamic development of the service and service, and new solutions (e.g. collaborative robots) are used in subsequent areas.

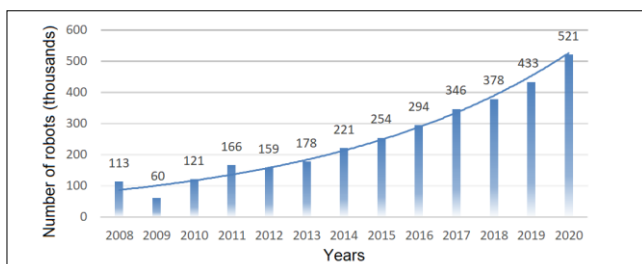


Fig. 1. Annual sales of industrial robots in the world – forecast for 2017–2020 [1]

The greatest opportunities for robotics are in the automotive and electronics industries. Specialists have noticed, however, that the food industry is also one of the most important markets for automation and robotics manufacturers. Its unstoppable development forces constant lowering of production costs and increasing the efficiency of technological processes; it also affects the quality of the manufactured products [2, 4].

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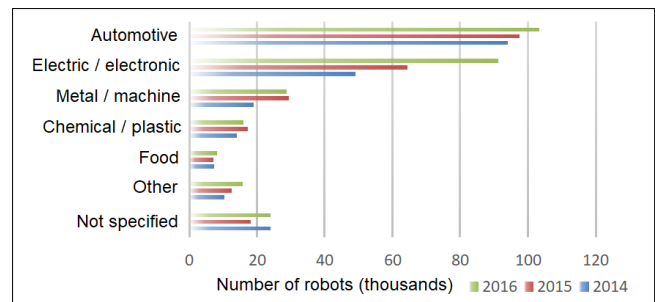


Fig. 2. Sale of industrial robots in selected industry sectors in 2014–2016 [1]

Industrial robots and the food industry

In the food industry, industrial robots are mainly used in pick & place processes. You can distinguish among them: sorting, packing, palletizing and depalletizing [1, 2]. In sorting/packaging applications, fast industrial robots are used (e.g. DELTA or SCARA type – fig. 3), which is characterized by:

- small range of lifting capacity (about 0.5÷8 kg),
- high speeds (up to 10 m/s),
- small working space, which is most often adapted to the width of the conveyor,
- high repeatability (about 0.03÷0.2 mm),
- cooperation with vision systems tracking products on transport lines,
- multi-purpose position support [4].

Works used in the food industry often require special construction solutions (housings, covers, additional seals of movable elements protecting against water, acids, cleaning agents, etc.) [2, 9–11].



Fig. 3. Sorting station in Robotics Laboratory WAT with IRB360

Programs supporting the creation of packaging applications

The demands and popularity of automation of packaging and sorting processes have meant that industrial robots manufacturers offer specialized programs or software modules that support programmers, such as ABB's PickMaster 3 and Picking PowerPac.

The PickMaster 3 program is based on PC software (32-bit) and is designed to support programming for IRC5 controllers. PickMaster is a configurator and controller for robotic robots for packaging with feeders. The PickMaster 3 can control up to 10 robots and 10 cameras in one application or on independent stations, whereby each robot can track up to six trays with 25 work areas for each robot.

Pickup PowerPac is a specialist package of the RobotStudio environment. It supports the programming of packaging applications. The package complements the PickMaster 3 software and allows real-time simulation of packaging lines in RobotStudio offline.

Algorithm for creating a sorting/packaging application using the PickMaster 3 program

The PickMaster 3 software requires a hardware key, and the computer on which it will be installed must have at least two Ethernet cards: one will provide a computer connection to the robot controller and the rest will serve the camera of the production station.

The algorithm for creating a sorting/packaging application using the PickMaster 3 program can be divided into:

- creating a line,
- preparation of the robot,
- project creation.

Creating a line

Creating a line in the PickMaster 3 program consists in preparing the hardware configuration of the production station. Fig. 4 shows an example of a line consisting of: 4 – camera, 5 – IRC5 controller, 6 – two feeders (input and output). More complex lines are equipped with more of the same elements. Depending on the mode of operation of the station, you can choose one of two methods for operating the pickup and storage area (fig. 4):

- Conveyor Work Area – work of the robot on the fly with the tracking of the transporter,
- Indexed Work Area – postponing details for a fixed position, e.g. to a box.

In fig. 5 the workspace configuration windows is presented.

As part of creating the line, you should also configure the cameras (for the given scene you need to set the white balance and the origin of the coordinate system, and calibrate) the cameras.

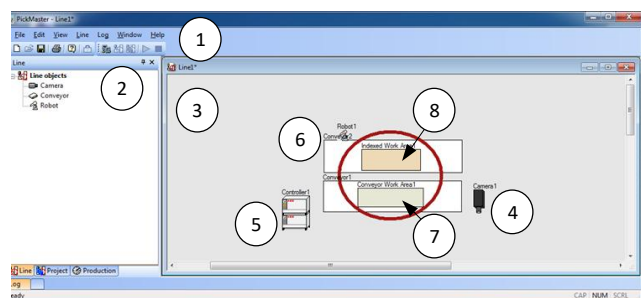


Fig. 4. View of the PickMaster 3 program: 1 – tool bar, 2 – line, 3 – line window, 4 – camera, 5 – IRC5 controller, 6 – two feeders (input and output), 7 – Conveyor Work Area, 8 – Indexed Work Area

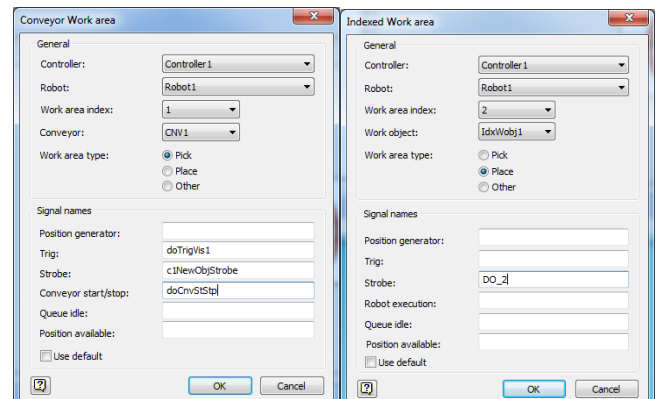


Fig. 5. Dialog box: Conveyor Work Area (on the left – part retrieval zone) and Indexed Work Area (on the right – part shelving zone)

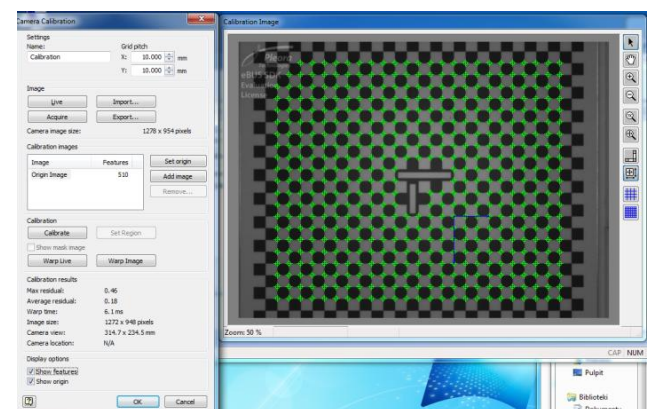


Fig. 6. Calibration window after correct calibration of the camera

Preparation of the robot

The industrial robot should be prepared in accordance with the options selected during the creation of the line. In this case, it will be to calibrate the robot for the transporter and the defined zone.

Calibration for the Conveyor Work Area is carried out by setting its base coordinate system (Base Frame) by four points (fig. 7). The setting for the defined area (Indexed Work Area) is performed by defining the coordinate system of the work object (WorkObject). For the simplest case, this can be done using the three-point method (fig. 7).

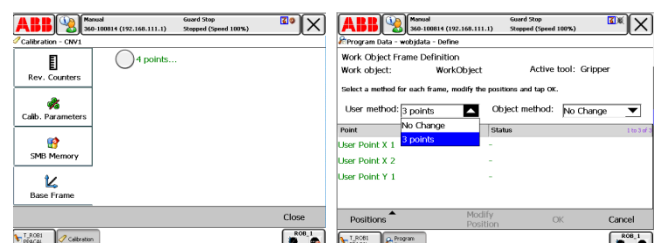


Fig. 7. FlexPendant panel screens (on the left – Base Frame setting, on the right – Define a WorkObject data)

Creating a project

The PickMaster 3 program allows to create many projects for a given hardware line. Creating a project is nothing but defining the logic of the work of a robotized production station.

First of all, you must configure the parameters of the manipulation objects (their dimensions) and the rules for their detection as a configuration of the position source (Position Source Configuration).

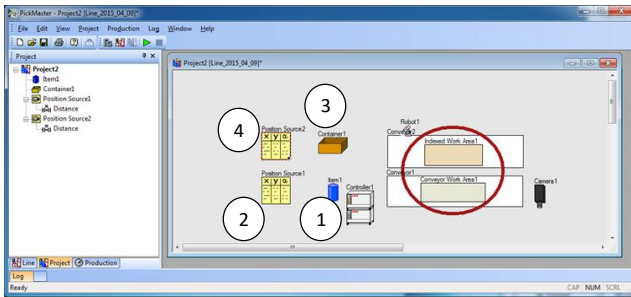


Fig. 8. Project configuration window: 1 – Item (features of manipulation object), 2 – Position Source1 (configuration of handling manipulation objects), 3 – Container1 (configuration of container handling), 4 – Position Source2 (configuration of container handling)

In fig. 9, the object (Model1) is detected by the vision system – cameras – after the transporter moves by a certain distance. When using a vision system, it is necessary to teach this system to recognize selected features of manipulation objects (e.g. shapes, colors, codes).

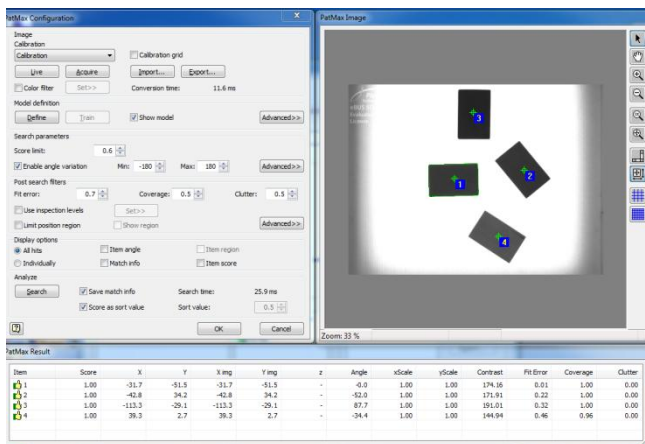


Fig. 9. Window for configuration of video system parameters

Defining a container consists in defining the pattern of placing details (for example, on the cardboard) and the number and type of layers. It remains to add a robot control program and you can test the application.

The ABB company provides, with the PickMaster 3 program, exemplary operating programs, thanks to which it is not necessary to create a program from the beginning. Just upload the sample control program and adapt it to your application [7].

Testing the correct functioning of the production site

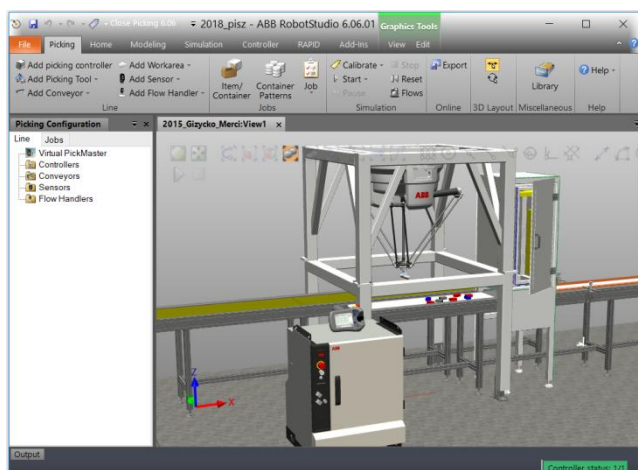


Fig. 10. RobotStudio environment with Picking PowerPac

When testing the application, it should be optimized in such a way that it works quickly and correctly, including: choose the height of picking up details, the time of downloading, the time of suction cups activation, the size of the product download zone. A useful feature of the PickMaster 3 program is the ability to adjust the position during automatic operation without stopping the station.

The sample product sorting application has been prepared and started in the computer simulation mode (fig. 10) and in the actual station (fig. 3).

Conclusions

Robotization of the sorting application is widely used in many branches of production (especially food, pharmaceutical, electronic, production of various types of components). Due to the great interest in the robotization of packaging and sorting processes, manufacturers of industrial robots offer specialized programs or program modules that can support programmers in creating robot control applications.

Examples are ABB products: PickMaster 3 and Picking PowerPac.

The algorithm presented in the article allows for the preparation of a sorting/packing station. The article was based on an application prepared in a virtual environment (fig. 10) and in the actual position (fig. 3).

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